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Wright.
774 Certain Errors in Navigation Detected, *diagrams* (*no title*, *w.a.f.*) [1610 ?], and 1 other 3 vols

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N. VIII

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1599

This Book formerly belonged to Wm Molyneux Esq
Fellow of the Royal Society in Dublin and also of
Gray's Inn London Author of Dioptrica Nova Astronomicum
and other Learned Works

Wilto: Molyneux

Certaine
ERRORS IN
NAVIGATION
Detected and
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Additions to this edition that were *not in the former.*

1 THe table for the true diuiding of a meridian of the Sea-chart, heere called the table of Latitudes, made to euery minute of the quadrant, which in the former edition was to euery tenth minute, from page 21 to the 112.

2 Diuers additions concerning the true graduating and making both of a general and particular Sea-chart ... ching the vse of the table of Latitudes, ... Chapter.

... umbe or Heliſphærical line ... giuen, to finde preſently ... itude giuen, pag. 128. ... exactly calculated ... h rumbe calcula- ... to the former:

... pag.

ecliptick, newly and exactly calculated in degr. min. and seconds, to the greatest obliquitie of 23 degrees, 31 min. 30 seconds, from pag. 237, to 297.

10 The table of Obseruations of the Sunne, corrected by his parallax, from pag. 310, to 329.

11 The eccentricitie of the Sun, the place of his apogæum, and tables of his middle motions, found out and corrected according to the said obseruations in Chap. 20, 21.

12 A new Theorick of the Sun, and the manner of making the table of the Sunnes prosthaphæreses thereby, from pag. 349, to 355.

13 New Ephemerides of the Sun for fiue yeeres, and how to make them and continue them for many yeeres past or to come, from pag. 356 to 386.

14 A new table of the Sunnes declination for the mariners vse, and how by certain prosthaphæreses to continue the same for many yeers, frō pag. 390 to 422.

15 The errors of *Simon Steuin* in finding fault with my table of Rumbs, from the 452 pag. to the 472.

16 A short treatise of ẏ whole Art of Nauigation.

17 A new and exact table of the Suns declination made, and to be vsed according to the ordinarie manner wherewith Englisli mariners haue been most acquainted: from pag. 99 to 112.

18 A most easie and exact way to finde the true height of the pole in any north latitude by knowledge of the height of the pole-starre, when the guard is in any of those 8 ordinarie positions, commonly noted amongst Seamen: from pag. 113 to 122.

19 A table of obseruations of the variation of the Compasse, taken in all parts of the world almost whither any nauigation hath been made in our age.

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TO THE HIGH AND MIGHTIE PRINCE

HENRY, Prince of *VVales*, Duke of *Cornwall*, Earle of *Chester*, &c. and eldest Son to our soueraigne Lord IAMES, King of great *Britaine*, *France* and *Ireland*.

S your Highnesse honourable accoũt of the Art of Nauigation, hath latelie appeared to the world, in building such a goodly & princely Royall Ship, as in the opinion of men of skill in that kinde, may iustly be compared with the best that floateth on the seas in these daies: So hauing hitherto spent the best of my time in such studies as containe the first and principall

grounds of that moſt admirable Art, and finding many notorious errors, as well in the books of the chiefeſt authors that haue written thereof, as alſo in the daily practiſe of our beſt Nauigators, following (for want of better) the rules preſcribed by thoſe authors, I thought my ſelfe bound in dutie, eſpecially ſince the beginning of the building of that Ship, to beſtow my beſt endeuour in correcting thoſe errors and perfecting ſo excellent an Art ſo much as I could; that as both the skill of our chiefeſt builders of ſhips in directing, as alſo the induſtrie of the inferiour workmen the Shipwrights, in executing their direction in building ſhips of all faſhions, for all purpoſes on land, ſeemeth in our time to be growne almoſt to the higheſt pitch of perfection; ſo both our Maſters and mariners at ſea, though alreadie they haue ſhewed and approued themſelues comparable with the beſt of any other nation, may in their kinde alſo bee found nothing inferiour to the other, in the well gouerning and ſafe and ſpeedie carying of thoſe ſhips to all parts of the world, whither they may haue

occaſion

occasion to goe, if hereafter it shall fall out to be either your Highnesse pleasure, or the desire of any other honorable and worthie Patriots for the glorie of God, the honor of their natiue countrie, and their own immortall fame, to set them foorth, for the discouerie of strange and forraine lands and nations yet vnknowne, whereby the poore people there liuing in darknesse and in the shadow of death, hauing hitherto been bred and brought vp in most wofull and horrible idolatries and superstitions, deuoting themselues, and in diuers places sacrificing one another to Diuels, in stead of worshipping the euerliuing God, may in short time grow to some acquaintance and familiaritie with this our Christian world, & in the end come to the sauing knowledge of the true God, and of their and our blessed Sauiour and Redeemer: which most worthie worke of God, will assuredly before his presence at the last day, bring much more profit, comfort, yea and honor also to the authors and effecters thereof, then all the victories and conquests of great *Alexander* and *Cæsar* and all

the reſt of the mightieſt Monarchs that euer liued in this world. And ſurely, moſt worthy and noble Prince, in whoſe yonger yeeres many excellent vertues and graces of God doe euidently ſhew themſelues, euen God himſelfe alſo the great ruler of this world, in his diuine prouidence and adminiſtration thereof, apparantly ſeemeth to aime at this marke: for elſe what ſhould it meane that within theſe few ſcores of yeeres (in a manner) hee hath diſcouered to the world the greateſt and rareſt ſecrets of the Art of Nauigation, farre exceeding all that could bee found out by the wit and induſtrie of man in diuers thouſands of yeeres before, firſt in reuealing that moſt excellent and wonderfull propertie of the Loadſtone, and needle touched therewith, in pointing North and South; whereby in the cloſeſt weather and darkeſt nights the mariner, who otherwiſe ſhould bee will (as they ſay) and at his wits end, not knowing which way to winde or turne himſelf, might notwithſtanding know (as it were by a meſſenger ſent from heauen) what wind bloweth, and towards what

part

part of the world his shippe goeth at all times.

Secondly, in manifesting vnto vs the declining qualitie of the same needle, whereby in most places of the world it declineth or varieth from the true points of North and South towards the East or West, which is therefore called the variation, or northeasting and northwesting of the Compasse, or Magneticall needle. Which at the first discouerie of the needles north-pointing was not marked, afterward it was doubted of by some, and by others (as namely by *Peter of Medina*) vtterly denied, and with many arguments opposed and disputed against, as a great imperfection and absurditie, most vnworthie the dignitie and excellencie of a stone so pretious as the Loadstone is, and therefore by him ascribed, only to the rude and grosse obseruations of mariners: and by others to the vnskilfull touching of the needle, not with the true north and south points of the stone, but with some other parts thereof. Yet now in our time by manifold and exact obseruations both of our

owne countrie men, and diuers others in all parts of the world almost, whither any Nauigation hath been made; this variation is manifestly prooued, and found not only no disgrace or imperfection, but a singular increase and augmentation of price and excellencie to that (otherwise most pretious) stone; in that not only by meanes of the first discouered north-pointing propertie thereof, it directeth vs towards what part of the world, or vpon what point of the Compasse we should guide our selues at sea: but further also by this varying or declining of the needle in some places of the world eastward, in some westward, in some places much, in some other little, and in some nothing at all: and yet alwaies certaine, and the same at the same place: by this variation, I say, and this varietie thereof, the industrious obseruing seaman, when hee hath diligently obserued the same in any place at sea, together with the latitude of the same place, keeping a note of those obseruations, doth by the like obseruations at any other time when he shall haue occasion to trauell that way, easily know, when

when hee commeth at, or neere the same place againe, and so by this variation performeth almost so much in effect as the inuention of the longitude.

To these adde the third rare and admirable propertie of the inclination, lately found in the Magneticall needle; whereby (so soone as it hath been touched with the stone) the north end thereof in all this our northerne hemisphære immediatly falleth a certaine number of degrees vnder the Horizon, and in all the other Southerne halfe of the earth beyond the Line, it riseth as much aboue the same. Which strange propertie, first by chance found out but a fewe yeeres since by the ingenious Artificer our countriman *Robert Norman*, and then much more discouered by Doctor *Gilbert* and that Reuerend Diuine your H. Chaplaine M^r. *William Barlowe*, industrious & happie searchers and finders out of many rare magneticall secrets; and lastly approoued and confirmed, by the obseruation and experience of diuers our best Nauigators at sea, in their longest voyages both North and South.

South: this inclination, I say, of the magneticall needle, if it be well and artificially handled, and obserued with meete and conuenient instruments for such a purpose, affoordeth in a manner the like hope of finding as much in effect as the latitude, as the variation doth of the longitude, and that also in the closest weather and darkest nights that can happen.

But now leauing this little magneticall earth a while, let vs in our thoughts ascend to heauen, and there consider of those diuine helpes which God from thence affoordeth vs for Nauigation, in the beholding and obseruing of those glorious celestiall bodies, the Sunne, I say, the Moone and Starres, the only sure and euident markes the mariner hath at sea, whereby hee may safely and certainly rectifie his course when he hath for many weekes (and moneths also sometimes) sailed vpon the vast Ocean without sight of any land at all, nothing else being to be seene all that while, but *Cœlum vndique, & vndique pontus:* let vs now, I say, (when all land marks haue been lost and out of sight for a long time)

time) consider of those faire markes cleerly shining in the heauens, and from thence appearing vnto the sight & view of the whole world: It is assuredly very much worth the noting, that euen in this our time also, those heauenly bodies haue been much more diligentlie and exactlie obserued, and their places and all their motions much more truly found out, then euer they were before in all preceding ages; whereby the table of the declination of the Sunne and fixed starres, which haue in former times been very faultie, erring not only a great many of minutes but in whole degrees also, some of them, and those also euen of the principall, and by mariners most obserued fixed starres; those tables, I say, of declination both of the Sunne and fixed starres are now brought to that perfection, euen in this booke here following, that scarse one minute of error can bee found in them, which at sea is a matter of very small moment, and by the mariner not possible to bee there obserued. Notwithstanding such kinde of instruments, and maner of obseruation are lately growne in vse

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amongst some of them, as I perswade my self can hardly be amended. Which also maketh not a little to the proofe of my purpose now in hand, considering that not only these, but all sorts of instruments needfull for Nauigation are now in growing, and very shortly like to come to farre greater perfection then hitherto they euer had. Amongst which instruments the Sea-chart and Compasse may worthily be accounted the chiefest. The first of which is in this booke also so corrected and reformed, that all the faults found therein by *Petrus Nonius* in his booke *de Reg. instrument. & obseruationibus Geometr.* and by *Martin Cortese*, (in his booke of the Art of Nauigation to *Charles* the 5, Emperor) or any other * are cleerely auoided, and the whole chart generally so amended, that it sheweth all things needfull for the vse of Nauigation as truly as the Globe it self can doe. Neither will the Compasse tarrie long behind the rest in recouering his perfection also, which alreadie beginneth to be freed from that rude and grosse manner of handling, which in the making thereof was generally

* *Sir Humfrey Gilbert.*
Mr. William Burrough.
Mr. Rob. Hues.

rally wont to be vsed. So that wee may vniuersally and truly conclude, that euen in our time the whole Art of Nauigation is growne to much greater perfection, then by the relation of any ancient or moderne histories or writers, it can appeare that euer it had in any former ages.

Neither doth this perfection we speak of, shew it selfe in the Art only, but in many of the artsmen themselues also (I meane the mariners and seamen) that daily practise and exercise that Art: the rules and grounds whereof they find by their often experience so certaine and infallible, that with assured confidence next vnder God, resting themselues vpon the certaintie of their Art; they are within these few yeeres growne to such courage and resolution, that being set forth by our worthy prouident and resolute Merchants, they seeme to make no more account of sailing to the vtmost *VVest* and *East Indies*, yea euen as farre as *Japan* and *China*, then in times past many would haue made to crosse ouer the sea, to our next neighbours. Nay euen the very compassing and sailing round

round about the whole Globe of this our inferiour world, (as twice hath been done in our time by those worthie famous Gentlemen Sir *Francis Drake*, and Mr. *Thomas Candish*, the first leaders that euer accomplished so strange and dangerous an enterprise in their owne persons) the compassing, I say, of this whole earth seemeth now adaies to many of our mariners no great matter; who so ordinarily passe ouer the greatest seas of the world euery way, as if there were continuall bridges to all coasts built ouer the same: nay rather indeed with much more conueniencie, safetie, and facilitie, then if the whole Ocean were euery where vaulted or arched ouer from one shore to another.

The effects and fruites of this their skill, courage and resolution, haue very apparantly and plentifully shewed themselues euen within this short time of your H. continuance within this Realme of *England*, in which time there hath bin as much or more found out by our nation both by sea and land, then in as many yeeres before hath bin; aswell in searching the *Northeast* and *Northwest passages*,

sages, as also in discouering the seacoasts and inland of *Virginea*, *Newfoundland*, *Groenland*, and the north *Newland*, as farre as *Hackluyts headland*, within 9 degrees of the Pole: also of *Guiana*, and diuers parts and Ilands of the *East Indies*; yea and some parts also of the South continent, discouered by the worthie Knight Sir *Richard Hawkins*, a little before his entrance into the Straits of *Magellan*, and his voyage into the *South Sea*, which himself hath diligently set downe since his returne out of his long Spanish Captiuitie into *England*, which was but the winter before your Highnesse happie comming into this Kingdome. And good hope there is, that this perfection which we haue spoken of, both of the Art of Nauigation, and of the Artsmen the Nauigators also, will not long rest or remaine at stay, as now they are, but bee still proceeding and daily growing on to more perfection euerie way. Some comfortable ground whereof hath not long since appeared in the Worshipfull Societie of the *Trinitie house*, who haue been so greatly encouraged by the singular fauour of his Maiestie,

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in renewing their priuileges and corporation, that of late, especially by the discreete & careful gouernment of Mr. *Hugh Merrick*, (their Master at this time) they haue reformed many grosse and dangerous enormities; and cease not there, but intend also to found the long wished for Lecture of the Art of Nauigation, and a Graund Pilot, as *Sebastian Cabot* was, first in *Spaine*, and afterward confirmed here in *England*, with an honorable pension of 166 pound, 13 shillings and foure pence, to him granted by King *Edward* the 6; as is to be seene in the office of the Rolles, and in the third volume of Mr. *Hackluyts* voyages, pag. 10. Both which [*Lecture and Pilot*] how necessarie and profitable they will be in this State and time especially, wherein we now liue, (our Merchants and Mariners daily vndertaking and putting in vre the longest Nauigations in the world) may euidently appeare by the experience of many yeeres in the Contractation house of *Seuil* in *Spaine*, where the renowned Emperour *Charles* the fifth considering the manifold losses and wracks, which through

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the ignorance and vnskilfulnes of his sea-men, both himselfe and his people sustained in sailing to and from the *VVest Indies*; for redresse hereof appointed a Pilot maior to examine such as sought to take charge of ships, and also founded a Lecture of Nauigation, which euer since his time hath been there continued, as it may appeare by the bookes which the Readers of that Lecture haue set foorth with the King of *Spaine* his priuilege. And how acceptable such a Lecture will be to our sea-men and mariners, it hath alreadie appeared in many of them, who although they had nothing else where-with to sustaine themselues, but what they got by banishing themselues (as it were) from their neerest friends and natiue countrie, to remaine in a wooden prison, alwaies within one spanne of present death, with the dangerous aduenture of their dearest liues also at sea many times; haue yet been content to impart some good portion ther-of for their better instruction, in such points whereof they were ignorant.

To the furtherance therefore of so neces-

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sarie, profitable and charitable a worke, as the founding of this Lecture will be, if your H. shall vouchsafe to giue countenance and incouragement, it will no doubt after many attempts be now brought to very good effect, to the great benefit of thousands of our Merchants and mariners, whom you shall hereby deeply binde to be thankfull to God and your H. for your princely care of their common good; and my selfe also for this and many other tokens of your gratious fauour towards me, of late especiallie when I least expected, to be a continuall suitour to the Almightie for the increase and continuance of all his blessings to you both temporall and eternall.

Your Highnesse most humbly deuoted Seruant,

Ed. Wright.

THE PREFACE TO THE READER.

THE Art of Nauigation (as it is called) though it hath now been in vſe ſome thouſands of yeeres, yet how farre it is at this day from the perfection which is and were to be deſired, wee would ſcarce beleeue (as a wonder that a thing of ſo great commoditie, ſhould no more be ſought into, in ſo many ages:) but that both the bookes of the learned are extant, to teſtifie, and reaſon (approued by often triall) doth plainly ſhew that the principal meanes, and Inſtruments this Art vſeth, haue been thus long ſo farre from this perfection, that contrariwiſe they haue been and are much ſtained with many blots and blemiſhes of error and imperfection.

1 The Sea-chart (the beſt meane the mariner hath to know the courſe from place to place) as it hath bin hitherto generally made, is ſo faultie in the very foundation and ground-work thereof (that is, in the geometricall lineaments of the meridians, parallels, and rumbs deſcribed therein) that hereof there may ariſe ſo groſſe error, as may cauſe the mariner to miſſe one, two, yea three whole points of the Compaſſe (and more ſometimes in a farre Northerly or Southerly nauigation) in finding the courſe from

place to place. Whereof it may also be necessarily inferred, that following the direction of his Chart, in such sort as hath been used for finding the distances of places, he may erre twice, yea thrice so much as the whole distance commeth to, and more sometimes in those Northerne parts, in taking the distance to bee twice, thrice, yea foure times greater then indeed it is.

2 The Compasse, the chiefest Instrument for keeping the course, shewed by the Chart, by the variation neglected (as by some it hath been) may cause you erre an whole point or two in the courses of diuers places: and not rightly vsed, hath bred much confusion in many parts of the Chart, in laying out many places in false courses: which must needs follow when the Chart is made according to the direction shewed by the points of the Compasse, without abatement or allowance answerable to the variation in euery place. This may especially be seene in those places where the variation is greatest; as vpon the coast of *Florida*, *Noua Francia*, and Newfound land: where some also seeking to auoid this inconuenience, haue fallen into another as ill or worse then the former, in making a double scale of latitude. And thus one error as a fruitfull mother breeding another, and one absurditie admitted drawing many with it: it will manifestly appeare by exact discourse out of these grounds (that partly through the false proiection of the Chart, & partly through neglecting, or not rightly vsing the variation of the Compasse) that it cannot otherwise be, but that the ordinarie Charts are in many places much

much like an inextricable labyrinth of error, out of which it will be very hard for a man easily to vnwinde himselfe.

Hereto accord the often experiments and vsuall practise of many well experienced and iudiciall mariners and seamen of our time, who confesse that in sailing from the West Indies to the Azores, they haue often fallen with those Ilands, when by their account, according to the Chart, they should haue been 150, or two hundred leagues to the westwards of them. The like hath been found in sailing from the Azores for *Vshent*, as I haue also partly seene in the little experience I haue had at sea; where wee were come within sight of that Iland, when by account of the ordinarie Chart we should haue been fiftie leagues short of it.

And as concerning the courses from place to place, I haue obserued that some of our masters take a wise course, in not trusting to those courses which are shewed by their Charts. But first getting themselues into the height or parallel of ŷ place to which they are going: and withal knowing assuredly whether they be more Eastward or Westward then that place; they then proceed, alwaies heedfully keeping themselues vnder that parallel till they come to the place desired. Then which way of sailing there is none more certaine and infallible, for the sure finding of the place assigned: but it hath this inconuenience, that it maketh the way longer then otherwise it should be, if the straight course were kept.

But to returne to that from whence wee haue a little digressed: by these experiments and practise of

the skilfulleſt mariners, it is manifeſt that they themſelues doe often finde the imperfections of their Charts, in ſhewing the courſes and diſtances of many places each from other, wherto we may adioyne the experience of the beſt Hydrographers of our time, who daily making their Charts after the accuſtomed manner with ſtraight lined rumbes and degrees of latitude euery where equall, haue found ſuch difficulties in labouring to bring their marine deſcriptions to ſome due correſpondence of truth in the courſes, heights, and diſtances; that tired herewith in the end, they haue holden it impoſſible, to make the Chart agree in all theſe with the Globe. Wherein notwithſtanding they erre, by making too generall a concluſion, in holding that to be ſimplie impoſſible, which cannot be done by ſuch a way and meanes as they know and vſe.

3 The Croſſe-ſtaffe the principall Inſtrument, that hath at ſea been moſt generally vſed, for obſeruing the altitudes of the Sunne or ſtarres, thereby to know more aſſuredly the latitude, and ſo to examine and rectifie the account of the courſe kept by direction of the Compaſſe vpon the Chart, if there be not abatement made anſwerable to the eccentricitie of the eie (that is, to the diſtance wherewith the center or point wherein the ſight beams concurre within the eye is further backward then the end of the ſtaffe) may through neglect of this abatement cauſe error in taking the height obſerued to bee greater then indeed it is by 10, 20, 30 min. yea an whole degree, and more ſometimes, if the height be much, the ſtaffe ſmall, & the eccentricitie of the eye great.

4 But

4 But both this ſtaffe and all other Inſtruments (though neuer ſo well made and vſed) can do vs but ſmall pleaſure, for finding the latitude at ſea, if the declination of the Sunne and ſtarres which wee obſerue bee not alſo knowne. To this end therefore there haue been made tables of the declinations, both of the Sun and fixed ſtarres: yet ſuch as euen that which hath been publikely commended, as not differing from truth in any place aboue one minute (I meane the Regiment of the Sunne, ſet foorth by *R. N.*) doth notwithſtanding differ from truth in many places eleuen, twelue, or thirteene minutes. And as for the fixed ſtarres, ſcarce one of them hath his declination truly ſet downe, and agreeably to obſeruation. Yea euen the Pole-ſtarre it ſelf, though it be better knowne and more obſerued by the moſt part of ſeamen then all the reſt; and indeede as it mought be vſed (being to be obſerued at any time of the night all the yeere long) might ſtand them in as much ſtead for finding the latitude as al of the reſt almoſt: yet in the bookes of Nauigation that are moſt common amongſt Engliſh mariners, the diſtance thereof from the Pole is made to be in our time aboue 40 minutes more then it ſhould be. No maruell therefore if the mariners complaine (as I haue heard them ſometimes) that they cannot make their obſeruations of the latitude, by the Sunne and this ſtarre to agree.

Neither is there more truth to be looked for in the declination of many other principall fixed ſtars, publiſhed in thoſe bookes, diuers of them erring from truth one, two, yea (ſome of them) three whole

degrees and more, as in the treatiſe following ſhall be ſhewed. And theſe errors in the declination of the Sunne and fixed ſtarres, not only I, but alſo the right worſhipfull Sir *Chriſtopher Heydon* Knight, and the noble Lord of *Knudſtrupp Tycho Brahe* founder of Vraniburg, with the gratious Prince *VVilliam Landtgraue* of Haſſia, father of him that now is, haue often found by many and moſt diligent obſeruations, with large and exact Inſtruments, wherein both minutes and halfe minutes might bee eaſily diſcerned. Notwithſtanding, if any ſtand in doubt hereof, I wiſh that hee himſelfe alſo would beſtow no leſſe coſt, time and diligence to make often heedfull and exact obſeruation; then either the Prince of Haſſia, or *Tycho Brahe*, or at leaſt as I my ſelfe haue done; and then, let him beleeue that which he ſhall ſee to be true with his owne eyes.

Theſe errors therefore in the Chart, Compaſſe, Croſſe-ſtaffe, and declinations of the Sun and ſtars, I haue in the treatiſe following laboured to reforme to the vtmoſt (yea rather beyond the vtmoſt) of my poore abilitie, neglecting in the meane time other ſtudies, and courſes that might haue been more beneficiall to me: which may argue my good will to haue proceeded further, to the amendment of ſuch other faults and imperfections as yet remaine, beſides thoſe that are alreadie ſpecified, and that eſpecially in two points, that is, in the courſes, and longitudes of places.

The reforming of the Chart in reducing all places from thoſe varying courſes, wherein now they are ſet downe, to the true poſitions they haue each

from

from other, by ſeparating the variation (wherewith they are in the ordinary Charts for the moſt part intermingled) were a buſie peece of worke: yet ſuch as were moſt worthie, and neceſſarie to be laboured in, as without which the Charts, Maps, and Globes, or any other Hydrographicall, or Geographical deſcriptions, cannot be freed from many intricate abſurdities, wherewith now they muſt needes in many parts be peſtered: becauſe the courſes and poſitions of places are in them ſet downe as they were obſerued by the varying Compaſſe, without ſeparating the variation afterwards, that ſo the true courſes and poſitions of places might be knowne.

The longitude alſo would well deſerue both labour and coſt to be both skilfully and liberally beſtowed, for the finding thereof, whereby it were poſſible to bring it to that paſſe (the motions of the Sunne and Moone, and places of the fixed ſtarres being verified, whereof that noble *Tycho Brahe* hath affoorded great hope) ỳ the induſtrious and willing minded mariner might be capable thereof, in ſuch ſort that for the moſt part, when the Moone & fixed ſtarres appeare, he might be able hereby to know what longitude he is in (yea euen at ſea) more truly then many haue done by their dead reckonings in ſailing out of the bay of Mexico to the Azores, or from New-found-land to England, or almoſt from the Azores to England. But on land the longitude might by this meanes be found as exactly as the latitude hath been by many obſeruers at ſea. And ſo opportunities of obſeruatiõ with meet inſtruments on ſhore, not being neglected, (eſpecially in long

voyages, farre Eastward or Westward) many most notorious errors in the longitudes of places would in short time be corrected, wherewith the most excellent arts of Geographie, and Nauigation are very much blemished. For who that loueth truth, can patiently endure to heare the mariners common, and constant complaint of 150, or 200 leagues error in the distance between the bay of Mexico and the Azores? or (that which is yet most intollerable and monstrous) of 600 leagues difference in the distance betweene *Cape Mendosino* and *Cape California*, some making that distance to be twelue or thirteene hundred leagues, where others will haue it (and that more probably) to bee no more then six or seuen hundred.

But for as much as the charge, though not great, (to speake of) of prouiding meete meanes for supply of these wants in the courses and longitudes, (but chiefly in the latter) exceeds the meane abilitie of the most part of them that are most addicted to these vngainfull studies (I must not say vngratefull, although in these daies they proue most vnprofitable to their greatest louers) therefore they are for my part like to rest (as hitherto they haue done) vntouched, and only commended vnto a certaine kinde of hope (whether vaine or no I know not) of some Mecænas at length of munificent spirit to be stirred vp, to haue some due consideration both of these, and other such wants and imperfections, as yet remaine in so excellent an art as this of Nauigation is.

For surely there is no man (considering how many

ny other both ingenious and ingenuous, as well liberall as mæchanicall Arts doe yeeld their aide and ſeruice vnto this of Nauigation) that can denie the excellencie thereof, or the profitablenes either. But if he will, my purpoſe is not to ſtand vpon it, nor to conuince him by reaſons, by records, or by the more wonderful diſcoueries that haue bin performed in this our age, euen to the furtheſt parts of all ỹ earth, and round about the whole compaſſe of the ſame, whereby we haue been made partakers of the moſt rare and richeſt commodities and treaſures of the vtmoſt Indies and Ilands of the world, and they likewiſe haue participated with vs (or elſe they haue had the more wrong) in the moſt precious treaſures of heauenly truth. All which and much more then can be thought, or now ſpoken of, performed chiefly (next vnder Gods prouidence) by the rules and directions of this art, who ſeeth not that by how much the more excellent, and vnto mankind abundantly profitable it is, ſo much the leſſe ought any notorious error to be tolerated therein, and ſo much the more ought all whom it may concerne (yea but in good will only where it may doe good) to endeuour themſelues that it may be brought to the higheſt pitch of perfection. I know not then if any one be vnto ſo excellent an enterpriſe drawne on to giue the beſt furtherance hee can, why he ſhould for his labour fall into any danger of reprehenſion at all. Yet it may be, I ſhall be blamed by ſome, as being too buſie a fault-finder my ſelfe. For when they ſhal ſee their Charts and other Inſtruments controlled, which ſo long time haue gone for currant, ſome of them

them perhaps will ſcarcely with patience endure it. But they may bee pacified, if not by reaſon of the good that enſueth hereupon, yet towards me at the leaſt, becauſe the errors I point at in the Chart, haue been heretofore complained of by others, eſpecially by *Martin Corteſe*, and *Petrus Nonius*, out of whom moſt part of the firſt Chapter of the Treatiſe following is almoſt word for word tranſlated; I for my part deſiring rather that faults ſhould be found by others then by my ſelfe, and labouring much more, as for a thing much better, and farre more needfull, and profitable, to be a fault-mender, then a fault-finder. Or elſe I may ſo much the more be miſliked, becauſe in ſeeking to amend, ſome will thinke I take too much vpon me: For ſome will ſay, and of thoſe perhaps that haue been employed in ſea affaires all their life long, that all this we goe about is more then needs. For they without all this ado haue euer performed their charge with good ſucceſſe, and are now too old to giue eare to theſe innouations and new ſchoole trickes. But other ſeafaring men who acknowledge the need hereof, are aſhamed peraduenture to receiue (as it were) either correctiõ from the ſchooles, or direction from the land: and therefore ſtick not to condemne Vniuerſities, and all in compariſon of their long and daily experience. Others alſo as more indifferent for the matter, will yet haue a fling at the perſon, thinking this reformation, which is profeſſed, to ſpring out of other mens fountaines: All which (becauſe wee are now about a work of amendment) muſt alſo (if they will heare reaſon) amend their opinions. For the

firſt,

firſt, which ſeeme moſt vnreaſonable, doe not conſider (being addict to theſe vnreformed Inſtruments) how like they are to thoſe old ſhip-maſters, of whō Maſter *Bourne* maketh mention, who not many yeeres ſince, wedded likewiſe too much to their old accuſtomed vſage, haue mocked them that haue vſed Charts, or Croſſe-ſtaues, ſaying, they cared not for their ſheep skinnes, they could keepe a better account vpon a boord: and them that obſerued the Sunne or ſtarres for finding the latitude, they would call Sun-ſhooters, and Star-ſhooters, and ask if they had hit it. But marke what commeth hereof: for one of theſe Maſters was he, as I take it, of whom an ancient ſeaman (yet liuing, as I thinke) once told me, who hauing vndertaken the charge of conducting a ſhip from *England* to Saint *Michaels*, (the eaſtermoſt of the Azores) and after long ſeeking, not able to finde it, for ſhame and ſorrow caſt himſelf ouer boord. Wherefore theſe men, if they conſider it well, haue no cauſe to boaſt of ſucceſſe without skill; but to thank God for both, that is, for their great and often good hap and ſafetie, and for their skill alſo were it ſmaller then it is. For I will do them no wrong, but doe freely grant and acknowledge, that from any one place to other, the courſe, height and diſtance may be truly ſet downe in the ordinary Chart, wherein the Rumbes are right lines, and the degrees of latitude euery where equall: and ſo by that Chart they may ſaile truly enough from hence to *Ruſſie*, or *Iſland*, or any other place. But if by the way they ſhould croſſe ouer from the one to the other, following the direction that their Chart ſhew-

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eth them, they cannot but erre a great deale, either in course or distance, or both; especially in those Northerly nauigations. Why then should they, where there is danger of wandring, refuse helpe of any that is willing to shew a better course?

But to come to those that may perhaps obiect I doe but *actum agere*, in doing no more then hath bin done alreadie by *Gerardus Mercator* in his vniuersall Mappe of the world many yeeres since: and in publishing something already set foorth by *Iodocus Hondius*, in his greater Mappe of the world and of Europe, now of late: I must answer, that indeed by occasion of that Mappe of *Mercator*, I first thought of correcting so many, and grosse errors, and absurdities, as I haue alreadie touched, and are hereafter at large shewed in the common Sea-chart, by increasing the distances of the parallels from the æquinoctiall towards the Poles, in such sort, that at euery point of latitude in the Chart, a small part of the Meridian might haue the same proportion almost to the like part of the parallel, that it hath in the Globe. But the way how this should be done, I learned neither of *Mercator*, nor of any man else. And in that point I wish I had been as wise as hee in keeping it more charily to my selfe. For so perhaps it might haue been more beneficiall to me: neither should any man haue had cause to thinke at the first sight of the fourth Chapter of this booke, that all I haue there set down is stollen out of one of the foresaid Mappes of *Iodocus Hondius*. But were I brought before a Iudge, I should for my absolution, and *Iodocus* his condemnation, make the contrary to appeare, and

and that by his owne confeſſion in his letters to me, and to a friend of mine, which I haue to ſhew, written in Latin with his own hand: To me his writing engliſhed is thus much in effect:

I heare that you are ſomewhat offended with me, becauſe I haue taken thoſe few things out of your manuſcript booke, whereas I promiſed you that I would not publiſh it: which alſo I would in no wiſe doe without your leaue. For my conſcience ſomething grudged, euen to publiſh this little, if the diſtance of places would haue ſuffered me conueniently to ſend letters vnto you. I was purpoſed to haue ſet this foorth vnder your name: but I feared that you would be diſpleaſed therewith, becauſe I haue but rudely tranſlated it into Latin.

And in a letter to M. *Briggs*, now Profeſſor of Geometrie in *Greſham* Colledge, he writeth thus:

I haue written to M. *Wright* in excuſe of my ſelfe; I am very ſorrie that hee is angrie with me for that cauſe. I pray you learne of him how hee is affected towards me, and write backe vnto me, and excuſe me vnto him as much as you can. I would haue publiſhed his whole booke for the common good, if I might haue done it without breach of my faithfull promiſe. And ſurely my conſcience grudged to publiſh euen this little which I haue taken out of his booke: but the profit thereof moued me, &c.

The trueth is, that at his owne inſtant requeſt, when hee wrought as an Ingrauer here at London, ſome of my friends alſo, procured by his flatterie, perſwading me thereto, hee alſo aſſuring me vpon his faith and credit that he would not publiſh it, or

any

any part thereof without my knowledge and consent. But how well and honestly he hath performed that protestation grounded vpon faith and credit, the world may now see: and how vnthankfull hee hath been to me for that which hath been so gainfull to himselfe, (as may appeare by so common sale of his Mappes of the world, of Europe, Asia, Africa, and America, al which had yet been vnhatched, had he not learned the right way to lay the groundwork of them out of this booke) I my selfe know too well. But let him goe as he is.

Now if any shall thinke it to be beyond a landmans skill, to finde faults in matters belonging to the seamans profession; they must know, if they be yet to learne, that one that is but reasonably well acquainted with Geometricall conceits, may as well, if not better then most seamen, know the nature and properties of the sphæricall forme of the earth and sea, with all consequents and dependances thereof. By consideration whereof, the true vnderstanding and reason of the nautical planisphere, or Sea-chart, may by him that hath been but meanly conuersant in Mathematicall meditations, be better apprehended, then otherwise it can by the seafaring man, though he spend his whole life in sailing ouer all the seas in the world. The like may be said of ŷ Crosse-staffe, and Compasse, and of the regiments or tables of declination of the Sunne and fixed starres, and of all other the principall meanes and Instruments seruing for the Art of Nauigation. But it is strange to see the differēce of things that in this world is made by the difference of hands from which they are receiued,

ceiued, howsoeuer the things themselues be. For let *Hannibal* a Captaine discourse of warlike affaires, be it neuer so slightly and out of reason or season, yet all (forsooth) must needes be greatly esteemed and admired, because he so great a Captaine hath spoken it. But let *Phormio* a Philosopher speake of the same matter, especially in the hearing of *Hannibal*, be his speech furnished with neuer so much learning and iudgement, yet must he (there is no remedie) be either a foole or a madman for his hire. So by all likelihood, the case may stand with this poore Treatise of mine; which if it had come forth to publike view, from out of the bosome (as once it was like) of a Master at sea, of great reputed excellencie, it had no doubt then found ỹ fauour, which now like enough it shall want: all windes then would haue sweetly blowne it into the pleasantest hauen of euery mans (at least of euery sea-mans) fauourable entertainment. I shall therefore with their patience set down the matter as it was, that none may mistake a trueth, which is daughter, not only of time, but of occasion, as hereby may appeare. It is not vnknowne to some of good place and reckoning, that one of the skilfullest Nauigators (as hee was by many accounted) of our time & Nation, (who died in Sir *Francis Drakes* last voiage) when he came to that extremitie of sicknes, that hee saw there was no other way with him but one, was reported to haue gathered and bound together into a bundle all his nauticall notes and obseruations, and to haue cast them into the sea. But soone after, notwithstanding that report, there came more comfortable newes by a Captaine that was familiarly

miliarly acquainted and conuerſant with him in all that voyage, and during the whole time of his ſickneſs, in whoſe armes alſo he died: who mouing ſome ſpeech vnto him touching ſomething of Sir *Francis Drakes*, that might then after his death be expected to come to light concerning Nauigation; Tuſh (ſaith hee) for that matter there is not much to be looked for at his hands, he had but ſmall skill in that art. Why, and what will your ſelf then doe? (quoth that Captaine) Whereupon this great Nauigator drew foorth a booke out of his boſome, and deliuered it to this Captaine a little before his death. This booke was ſhewed by the ſame Captaine to the right Honourable the Lord high Admirall of England in the Cales voyage, as being made by that famous Nauigator, which his Lordſhip alſo (as it was reported) thought good ſhould be peruſed & publiſhed. Theſe newes moued ſome expectation of that booke: ſo as the right Honorable the Earle of *Cumberland* hearing of it, was deſirous alſo to haue a ſight thereof, and remembred me vnto that Captaine, as one not inſufficient to peruſe and correct the ſame. And hereupon the booke was brought vnto his Lordſhip, at the time and place appointed at *Weſtminſter*, and was there alſo deliuered vnto me to be peruſed and corrected. Hauing therfore opened it, & beginning a little to turne ouer the leaues, to take ſome generall view what matter might be contained therein: I firſt eſpied a Diagram, the like whereof I knew very well I had made in a book of mine. And herewithall I was the more moued to ſee if there were any more that I could know as well

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as the former: turning ouer therefore two or three leaues more, I presently espied another figure also, wherewith I was as well acquainted, as with the former: for I found not only the very same figure, but (that which made me the more to maruell for the present) following also in the same order, as I well remembred it did in my booke. Being therefore yet more earnestly stirred vp hereat, and wondring what the reason might be, that we should thus agree, I betooke my self to the reading of that booke. And looking first vpon the first leafe thereof, and afterwards in many other places, I found it euery where to agree with mine, and to be a copie of the same booke, word for word, which I made, and presented vnto his Lordship almost seuen yeeres before, as the next morning it plainly appeared, both to his Lordship and to the Captaine himself that brought it, by comparing it in all points, with the originall exemplar of the same booke, which I then brought vnto his Lordship.

One crime there yet remaineth which *Simon Stevin* of late hath charged me with in the former edition of my tables of Rumbs, namely, that I haue erred about 12 minutes in the latitude of the fourth rumbe at 78 degrees of longitude, and aboue two minutes in the latitude of the first rumbe from the meridian, before I come to so little as two degrees of longitude: whereby hee would prooue that my way of making the table of Rumbes should be erroneous. But the truth is, the error is not so much in my tables, as in his own too rash vnaduisednes, who out of no better ground then so grosse a manner of

triall, as hee vseth in finding out the latitudes of the Rumbes working by whole degrees of longitudes, would make the world beleeue I had committed so great errors in those tables; which latitudes if hee had sought by single minutes, he should not by his owne way and manner of account haue found so much as the sixtieth part of one minute difference from my way whereby I made those tables; which as it is of all other the most easie, so it is not inferiour in truth to any way that he hath or can deuise: his account, according to his owne waies, yeelding alwaies more then trueth, and mine something lesse; and yet not differing so much as one second one from another, if you worke his way exactly by small differences of longitude.

But I feare that whilest I labour to satisfie all, I shal offend some, as making too long a Preface to so smal a volume: I will therefore hasten to an end, only shewing ỹ summe of this Treatise: which I thought good to offer vnto your view, as a short abridgement of all that followeth, and rather to set it apart by it selfe, then to include it, as I was purposed, within this Preface, which is beyond his bounds alreadie.

The summe of the Treatise following.

THe Treatise following containeth foure principall parts; whereof the first may be called Hydrographicall, wherein are set downe the errors of the common Sea-chart, with right lined rumbs, and degrees of latitudes euery where equall: then the way

way to auoid theſe errors is geometrically demonſtrated, and out of this demonſtration a Table is calculated, and the uſe thereof ſhewed, for the true and eaſie diuiding of the Meridians in the Chart, both generall and particular, into ſingle minutes of latitude, increaſing in due proportion towards the Poles, whereto is adioyned, as ariſing from thence, the Table of the ſeuen firſt Rumbes, ſhewing by what points of longitude and latitude each of thoſe Rumbs is to be drawne, from the æquinoctiall till you come within a minute of the Pole: with helpe of which Tables, the Rumbes may in any Chart, Mappe, or Globe, much more truly be deſcribed, then by thoſe mæchanicall waies, long ſince publiſhed by *Petrus Nonius*, or lately practiſed by ſome Globe-makers in England. To which is annexed a table of the eighth Rumbe, ſhewing the quantitie of one degree of longitude at any latitude, in min. ſeconds and thirds of one degree of the æquinoctial. Which degree of longitude being diuided by 3 at any latitude, giueth you the number of leagues contained in one degree of the parallel at that latitude. By meanes of this table, the table of Rumbes may (according to *Steuins* way) be more truly and eaſily made or examined, then by that which he hath lately ſet foorth, 4 *libr. Geogr. de Hiſtiodromia.* After this followeth a moſt plaine and ſenſible demonſtration of the diſagreement of the common Sea-chart, and of the agreement of the Globe with the Chart before deſcribed, the vſe of which Chart is ſhewed in the Chapter next following: where alſo (the longitudes and latitudes of any two places being giuen)

uen) the way is set downe how to finde their distance, measured either in the segment of the rumb, or in the arch of the great circle that is drawne betweene them, both mechanically with ruler and compasse, and mathematically by the doctrine of triangles; whereby it may without much difficultie be conceiued how Nauigation may by Arithmeticall calculation only be performed without Chart or Globe, the longitudes onely and latitudes of the places from whence you come and whither you goe, being first knowne.

The second principall part of this Treatise may be called Magnetical, because it intreateth of the variation of the Compasse, shewing how the same may be found at sea (the latitude being giuen) by one obseruation of the Sunnes height, and point of the Compasse whereupon he is at the same instant, before or after noone, with helpe of the Globe or Astrolabe: which way of finding the variation is also exemplified, with a Table of such obseruations as I tooke both at sea and on shore, in the voyage of the right Honorable the Earle of Cumberland, in the yeere 1589. But this way of finding the variation, being something tedious, I haue now therefore hereto newly adioyned the making and vse of the seamans rings; an Instrument which long since I deuised for the present finding both of the variation and time of the day, at one instant, euen together with the obseruation, without any further trouble of vsing any other Instrument, or working, either mechanicall or Arithmeticall after you haue obserued. Yet because these Rings, and the Globe

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and Astrolabe also are such Instruments as euerie one cannot easily haue and vse at sea; I haue further shewed how by the Sunnes point of the Compasse (or Magnetical Azimuth) and altitude giuen by obseruation the variation may be found, either mechanically, with ruler and compasse, or mathematically by the doctrine of triangles, and arithmeticall calculation. And seeing moreouer that of late yeeres, diuers industrious seamen of our nation, haue begun to make some obseruation of that new found propertie of the magneticall needles inclination, or dipping vnder the Horizon, after it is touched with the Loadstone; by meanes whereof, it seemeth something probable, that seamen may haue some help to know their height or latitude in darke and cloudie weather, when neither Sunne, nor starres for many daies appeare, to be obserued: I thought it should not be impertinent to this place to set downe the Theorick that hath been deuised of this magnetical inclination, together with a demonstration for the making of a table thereof, to euery degree of latitude, according to that Theorick: to the end that such of our sea-men as meane to be diligent obseruers hereof, may make heedfull triall of that inclining propertie, and compare the same with this table, in all parts of the world where they shall trauell; especially in those long voyages to the East & West Indies, and in their Northeast or Northwest discoueries.

The third part may be called Geometrical, intreating of the Crosse-staffe, and shewing how such errors may be auoided, as haue been commonly committed

mitted in the vse thereof, either by reason of the parallax, or eccentricitie of the eye, or by the height of the eye aboue the water, or by the parallax or refraction of the Sun. And becaufe for finding the quantitie of the angle that is to be abated out of the apparent altitude of the Sunne or ſtarres, obſerued by this ſtaffe, for any height of the eye aboue the water; it was needfull to know the quantitie of the earths ſemidiameter, concerning which there is great varietie of opinions amongſt learned authors: I haue therefore in this part of this treatiſe now ſhewed diuers waies for the more certaine finding thereof; one of which waies I haue alſo for my more aſſurance exemplified by obſeruation, as meanes and opportunitie ſerued me, neere Plimmouth ſound, *anno* 1589.

The fourth and laſt part may be called Aſtronomicall, wherein my chiefe intent was to correct the errors that are in the ordinary Tables of declination of the Sunne, and fixed ſtarres. To which end there is firſt ſet downe a table of the declination of euery minute of the ecliptick, in degrees, minutes and ſeconds, calculated for the greateſt obliquitie of the Zodiack, as it is found by obſeruation in this age, 23 degrees, 31 minutes and an halfe. Whereto is adioyned the vſe thereof for the readie finding of the place of the Sun by his declination giuen: or contrariwiſe for finding the Suns declination, his place being firſt knowne. After this is ſhewed the way and meanes I vſed for exact obſeruation of the Suns Meridian altitudes, with a table of thoſe obſeruations, for foure yeeres together, that ſo the more

certaintie

certaintie might be had of the declinations and places, and consequently of the whole course and motion of the Sunne: and that by comparing together so many obseruations, the Sunnes eccentricitie and apogæum might the more assuredly be knowne. By knowledge whereof, the way was laid open for the correcting, and true making, of the Tables of the Suns middle motions and prosthaphæreses, which were necessarie helpes and meanes for calculating the Ephemerides of the Sun there set downe: without which the regiment or table of declination of the Sunne next following (which I may commend as free from error obseruable at sea, and seldome differing one minute from obseruation on land, and for which principally all the former paines were vndertaken) could not so easily haue been made. Now if any shall thinke that most of this fourth part going before this regiment, might haue been omitted, as being impertinent to the vse of mariners, and exceeding their capacitie: I answere, that it was not my purpose, neither could I in all places applie my selfe to the most part of sea-mens capacitie, knowing many that would not be content with this regiment alone, but that desired more to know the ground and roote from whence this fruit grew: whose desire I was also willing to satisfie as I could for the present, hauing seldome had a more inconuenient season for such a purpose. Then after some caution giuen, concerning the vse of this table of declination, and the æquation thereof in places farre differing in longitude from hence, there followeth a table of 32 principall fixed starres about the æquinoctiall,

ctiall, that haue been moſt commonly knowne and obſerued by ſeamen with their declinations corrected: and another table of as many more of the notableſt ſtarres about the North Pole is thereto annexed, with their diſtances from the Pole, corrected alſo and verified by diligent obſeruation on land. To theſe is added a Table of the Sunnes right aſcenſions (reſolued into houres and minutes) for euery day of the yeere with the vſe thereof, for finding at what houre any of thoſe ſtars commeth to the Meridian at any time of the yeere: that hereby the mariner might finde at all times, when they come to the Meridian, and ſo the eaſilier learne to know and obſerue them. Hereunto I haue newly adioyned the deſcription and vſe of an Inſtrument which may not vnfitly be called a Sea-quadrant; whereby is ſhewed, how the height of the Sunne at ſea, may by two obſeruers, be much more exactly obſerued, then by any other meanes before publiſhed: and how the height of the Pole may readily be found at any time of the night, by obſeruation of the Pole-ſtarre and guard, without making any abatement or allowance (as the manner hath been) in regard of the point of the Compaſſe, whereupon the guard is ſituate. But now for further ſatisfaction in euery one of theſe particulars, I referre the friendly reader to the Treatiſe it ſelfe heere following. Which *Simon Stevins* inconſiderate deſire of finding fault with my tables of Rumbes, hath cauſed me to conclude with an Anſwere to him, plainly ſhewing himſelfe, and not me, to be in the ſame fault that he would finde with me.

To

To this treatiſe (for the benefit of the younger and vnskilfuller ſort of ſeamen) it was thought not vnmeete to adioyne the ſhort treatiſe following, containing the ſumme of the whole art of Nauigation, firſt ſet foorth in Spaniſh by *Roderigo Samorano*, and ſince tranſlated into Engliſh, by a friend of mine, for the benefit of our Nation: which treatiſe I would wiſh all them that are but nouices, or new beginners in that Art, firſt to peruſe, and vnderſtand well, before they come to the reading of the former, which (for the reading thereof with the greater profit) requireth ſuch a one as is alreadie reaſonably well acquainted with the rules and principles of that Art; which I haue not hitherto knowne to be more briefly and plainly, nor yet more fully ſet downe and publiſhed in any other booke, then they are in that little treatiſe. This notwithſtanding I muſt admoniſh the Reader, that in ſtead of the Sea-chart therein deſcribed, according to the common error, with equall degrees of latitude, he follow that manner of making the ſame, which I haue in the former treatiſe ſet downe, Chap. 3, 4, 5, and 6. And that in ſtead of the rules and allowances for finding the latitude by the height of the Pole-ſtarre (which are many waies, and much erroneous) he muſt follow the tables adioyned to the end of that treatiſe; which for any of thoſe 8 poſitions of the guards, at which ſeamen vſe to take the height of the Pole-ſtarre, doe in any latitude truly ſhew the height of the Pole by the height of the Pole-ſtarre truly obſerued. Which tables, together with ſome others in the former treatiſe; as namely, that of the declination

tion of euery minute of the Eclipticke in the 17 chapter, together with those of the sunnes Prosthaphæreses, and Ephemerides in the 22 and 25 chapters, as also that of the suns declination chapter 27: I could not by reason of my many distractiõs intend to make my selfe: but was enforced to procure my kind friend M. *Henry Brigs* to vndertake that labour for me: which notwithstanding (I perswade my selfe) many will thinke might well haue been spared; being all vndertaken vpon no greater occasion then the error of one minute and a halfe in the sunnes greatest declination, which (by following the example of *Copernicus* and others, the chiefest Arts-maisters in Astronomie, in not regarding the sunnes parallax, when by his solstitiall altitude, and the height of the Pole, I sought the obliquitie of the Zodiack, and distance of the tropicks) was committed in those tables in the former edition of my booke of *Errors in Nauigation*.

But howsoeuer I may perhaps for this cause be censured by some, of too much curiositie; yet this I am sure of, that all Mariners and Sea-men, and whosoeuer else shall haue occasion to make vse of this booke, haue iust cause to thinke well of my carefulnesse herein; who would haue so much labour vndertaken, as to haue all those tables with great diligence newly calculated throughout: rather then so small a fault as that should in this edition also, passe on vncorrected. This labour therefore together with the rest, I commend to thy friendly acceptance. Farewell.

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FINIS.

CERTAINE ERRORS IN NAVIGATION CORRECTED.

Chap. I.

Faults in the common Sea Chart, with Rumbes expreſſed by right lines, and degrees of Latitude, euery where equall.

AS the Sea Chart is one of the moſt principall Inſtruments that Mariners haue for their direction in ſailing, ſo there is not any wherein there are ſo great and dangerous errors.

Error in the proportion of the length & breadth of places in the common ſea chart.

1 For firſt, what places ſoeuer are deſcribed therein, the length of them (from Eaſt to Weſt) hath a greater proportion to the breadth (from North to South) then indeede it ought to haue (except it be at the æquinoctial.) And ſo much the more this error increaſeth, by how much the further diſtant thoſe places are from the æquinoctial: euen as the proportion of the Meridian to the Parallel, increaſeth the more, the neerer you come to either Pole; ſo that at the parallel of 60 degrees latitude, the proportion

of the length to the breadth is twice greater than indeede it ſhould be; and that becauſe the meridian is double to that parallel, and ſo in all the reſt, the proportion of the length to the breadth ſhall be greater then the trueth, in the ſame proportion, wherewith the meridian exceedeth the parallel.

As for example: in the common ſea Chart, the proportion of the length of Frieſland, to the breadth thereof, is two fold greater than in the globe (which ſheweth the true proportion of the length to the breadth) becauſe the meridian is double to the parallel of that Iland. In the Ilands of Groenlant and Groclant, the length to the bredth hath a foure-fold greater proportion in the common Mariners chart, then it hath in the globe; becauſe the meridian is fourefolde greater then the parallel of thoſe places.

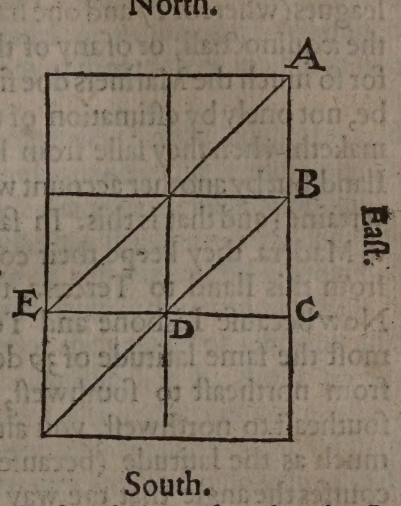
Error in finding out the difference of longitude by the common ſea Chart.

2 The way to finde out the difference of longitude, by the common ſea Chart, is true at the æquinoctiall onely, and neere about the ſame may bee vſed without ſenſible error: becauſe there onelie the meridian and parallel are æquall. But on this ſide or beyond the æquinoctial there is error committed proportionally to the difference of the meridian and parallel, that is, the difference of longitude found out by the Chart hath the ſame proportion to the true difference of longitude, that the parallel hath to the meridian.

As for example: at the parallel of 60 degrees in the common mariners Chart (wherein the degrees of the meridians, and parallels are equal) admit B D be two places bearing each from other ſouthweſt and northeaſt, differing in latitude ſo much as is the

arke

arke of the meridian B C, which for example sake we will suppose to bee one degree, therefore by the ordinary Chartes the difference of Longitude C D, shall bee likewise one degree: but yet in trueth because the meridiã is double to that parallel, and consequentlie, a degree of the meridian double to a degree of that parallel, therefore B differing a degree in latitude from D should bee placed twice so far from C, that is at A, so as A B C may all be counted but for one degree of the meridian, and so bee equal to two degrees of the parallel, whereof should follow that E C should be the difference of longitude, that is, two degrees, (as the trueth is in the globe) whereas the common Mariners Chart shewe-th the difference of longitude to bee but half so much. And yet notwithstanding if you goe nearer to the poles, you shal erre by their Chart a great deale more, euen as the proportion of the meridian to the parallel increaseth more and more.



But this error in shewing the difference of longitude, shall yet further appeare by this example of *Petrus Nonius*.

In the Mariners Chart, the distance betwixt Lisbone and Tercæra, is set downe to bee 262. Spanish leagues (whereof 17 and one halfe make a degree of the æquinoctiall, or of any of the greatest Circles) for so much the Mariners doe finde that distance to be, not onely by estimation of the way that the ship maketh, when they saile from East to West to that Iland, but by another account which is much more certaine; and that is this. In sayling from Lisbone to Madera, they keepe their course southwest, and from this Iland to Tercæra, they sayle northwest. Now because Lisbone and Tercæra haue both almost the same latitude of 39 degrees: and in sailing from northeast to southwest, and likewise from southeast to northwest, you alter the longitude as much as the latitude (because that in both those courses the angle that the way of the ship maketh with the meridian, is æquall to halfe a right angle: and the Iland of Madera hath almost 31 degrees and an halfe of latitude towards the north, so that the difference of the latitudes of Lisbon and Madera, as also of Madera and Tercæra is about 7 degrees and $\frac{1}{2}$.) Therfore the difference of the longitudes of Lisbone and Madera, and likewise of Madera and Tercæra shall be 7 and $\frac{1}{2}$ of the same degrees of the meridian, both which added together make the whole difference of longitude betwixt Lisbone and Tercæra, to bee 15 degrees of the meridian, which are equal to 262, and one halfe Spanish leagues. But in the parallel that passeth by the 39 degree of latitude, wherein (almost) Lisbone and Tercæra are placed, there are more degrees in the same space, according

to

to that proportion wherewith the meridian is greater then that parallel. Therefore the true difference of longitude betwixt Lisbone and Tercæra, that is, the arke of the parallel or æquinoctial conteined betwixt the meridians of those places shall thus bee found out:

It is a rule in Geometrie, that the diameters and peripheries, and consequently the semidiameters, and like arkes of circles haue the same proportion.

Also it is manifest that the sine of the complement of the distance of any parallel from the æquinoctial, is the semidiameter of the same parallel.

Now the distance of the parallel of Lisbone and Tercæra from the æquinoctial is about 39 degrees, the complement whereof is 51 degrees: whose sine is 777 which is the semidiameter of the foresaid parallel, in such parts whereof the whole sine conteineth 1000. which is the semidiameter of the meridian. Therefore by the rule of proportion inuersed, if 262 Spanish leagues make 15 degrees in the meridian, whose semidiameter is 1000 parts: then in the parallel whose semidiameter is 777 of the same partes, they shall make 19 degrees, and $\frac{237}{777}$ parts of one degree, that is, 18 min. and little more: which (if it be true that the course from Lisbone to Madera is southwest, and from Madera to Tercæra northwest: and that the latitude of Madera is 31 deg. 30 min. and the latitude of Lisbone and Tercæra 39 deg.) shall be the difference of longitude betwixt Lisbone and Tercæra. Whereas *Ortelius* and *Mercator* following as it seemeth the marine Chartes without correction in their vniuersal Maps, make them

to differ in longitude ſcarce 15 degrees of their parallel, as if it were æquall to the æquinoctiall line.

Errors in the lying and bearing of places one from another in the common ſea Chart.

3 Moreouer, they are deceiued not onely in the ſituation of many places, which the marine Chart ſheweth to be vnder the ſame Meridian: but alſo in the lying, or bearing of other places each from other. For the Meridian is a certaine rule of the poſitions of places. If therefore error ſhall bee committed in the ſituation of the Meridian, there muſt needes bee error in the inclinations of the other rumbes, pointes, or lines of the Compaſſe. And therefore not euery inclination, or reſpectiue poſition of place to place, which is ſet downe in the marine Chart, is to be taken for true: but that poſition or inclination onely, by which ſome haue ſailed from the one place to the other. This may be ſeene in ſayling to India. For the marine Chart placeth that promontorie of Africa, called the promontorie of 3 pointes, being in latitude towards the North, 4 degrees and one halfe, and the Ilands of Triſtan acugna (which haue 36 degrees of Southern latitude) vnder the ſelfe ſame Meridian: Alſo the marine Chart ſheweth the diſtance betweene theſe Ilands and the promontorie of Good Hope, to bee almoſt 400 leagues: both which notwithſtanding cannot ſtand together. For if all the ſhore from the promontorie of 3 pointes vnto the promontorie of Good Hope be rightly deſcribed, and the promontorie of 3 pointes alſo lie vnder the ſame Meridian with thoſe Ilands; the foreſaid diſtance muſt needes be much leſſe: But if it be not leſſe, it cannot bee that they ſhould haue the ſame

Meridian

Meridian with the promontorie of 3 pointes, but must needs bee more to the Westward. Hereof it commeth that the Mariners are very oft deceiued, when they go from one place to another, following that direction which the sea Chart sheweth them. Which place when they finde not by that course, they thinke that the cause of that error is either some swift current of the Sea, that carrieth them another way: or else the declination of the poles of the Loadestone, from the true poles of the world: although (perchance) they erred onely because they knew not how those places did beare one from another.

Error in setting of places out of the common sea Chart into the globe.

4 Neither are they onely deceiued in that, because they thinke that the sea Chart can shew the situations of all places: but also becaus that when they will translate the sea coastes out of the Chart into the Globe, they doe it, hauing respect onelie to the numbers of the degrees of longitude, and latitude found therein; and no otherwise then when they set the fixed starres into a cœlestiall globe. So it commeth to passe, that not onely those errors are committed, which doe necessarily arise out of the common sea Chart: but other errors also which might be auoyded, if they first turned into degrees, those distances of Longitude which they haue truly knowne, and then followed the Longitudes and latitudes of places.

Error in shewing the distances of places in the common sea Chart.

5 In shewing the distances of places, there is as great error committed, as in any of the former. For example: If you imagine 2 ships to bee vnder the æquinoctial 100 leagues asunder, and that each of them

them ſhould ſayle from thence due North or South vnder his Meridian, vntill they come to the parallel of 60 degrees latitude: they ſhould bee there but onely 50 leagues diſtant, becauſe at that parallel the Meridians are diſtant but halfe ſo much one from another, as they were at the æquinoctial as it may moſt manifeſtly appeare by the globe: and yet the Chart will ſhew, that thoſe two ſhippes haue the felfe ſame diſtance of 100 leagues, being vnder the parallel of 60 deg. which they had before, when they were vnder the æquinoctiall line.

Error in keeping alwaies the ſame point of the Compaſſe.

6 There is yet another error remaining (though all the former were auoyded) which ariſeth hereof, becauſe that by the direction of the Compaſſe they bend, and turne the ſhippe, in ſuch ſort, that they conſtraine it alwayes to make the ſame angles with the Meridian. As when they ſaile from Vſhent to Cape Raſo, both lying vnder the ſame parallel, they guide the ſhip in ſuch ſorte, that it maketh alwaies right angles with the Meridian, and ſo holding on their courſe due Weſt, they keepe themſelues alwaies vnder the ſame parallel; whereas notwithſtanding, there is a more certaine courſe, whereby they may goe from one place to another without that loſſe of way, which they muſt needs make that keepe themſelues alwaies vnder the ſame parallel.

There is moreouer another commoditie in this kinde of ſailing, that we may finde euery day by a more certaine accompt what way wee haue made, and know in what place we are.

But this way is not to bee defined by any of the leſſer circles, but by a great Circle which is to bee drawne

drawne by those two places: and the arke of that great Circle conteined betwixt the same places is lesse then the arke of the parallel which lieth betweene them, as may be concluded by an euident and necessary reason out of the principles of Geometrie: much like as a streight line is shorter then a crooked, both being extended betweene the same pricks. Therefore this commoditie is also hereunto adioyned, that in sayling by a great Circle, the way is more short, and compendious. But he that entreth into this course of sayling, must know, that he must often change the point of the Compasse whereupon he guideth the ship, because of the variable, and inconstant inæqualitie of the angles, which that great Circle maketh with euery new Meridian. Of which angles the inuention indeede (by the Chart especially) is very subtile, and consisteth herein (to wit) in knowing how much such kinde of angles doe decrease, or increase as the ship goeth forwards. And he that so shapeth his course, goeth the streight and neerest way. Otherwise it cannot be that a man should keepe a streight course, if he shall continually follow one and the same point, or line of the Compasse, (except hee saile vnder a Meridian, or vnder the æquinoctiall line:) but hee must chaunge the point of the Compasse so often as that streight course shall sensibly require.

And therefore it cannot bee by any meanes that the Mariners, when they goe perpetually towards the same part of the world, keeping the same angle of position in respect of the Meridian, or the same

point of the Compaſſe; ſhould goe the ſhorteſt and neareſt way.

This kind of ſayling vnder a great Circle, is of eſpeciall vſe in our northerne Nauigations, for the diſcouery of the northeaſt or northweſt paſſage: which as it may moſt eaſily be performed by help of an hydrographicall globe, with the heliſphæricall lines drawne thereupon: ſo for them, that liſt not be troubled with the comberſom carriage and charge of the globe, it may be done (in a manner) with no leſſe facilitie by a nauticall planiſphære, made after the proiection of *Gemma Frieſius* his aſtrolabe, whereof more hereafter when God ſhall giue leiſure.

The expreſſing of the rumbes by right lines defended: which ſome hold for erroneous.

There be ſome alſo that hold it for erroneous, that the rumbes in the mariners Chart ſhould be expreſſed by right lines, and conſequently that the meridians ſhould be parallels, or æquidiſtant euery where; which becauſe it is but barely affirmed, and the contrarie may bee prooued, as well as that each rumbe except the rumbe of North and South maketh æquall angles with euery meridian: wee hold it not onely as true, but alſo as moſt meete & commodious for the Mariners common vſe, that the meridians in the ſea Chart ſhould bee euery where æquidiſtant each from other, and conſequently that the rumbes ſhould be ſtreight lines for theſe two cauſes.

Firſt becauſe the rumbes or points of the Compaſſe may ſo moſt eaſily bee drawne in the nauticall Planiſphære, onely by a ſtreight ruler. For ſeeing that any one and the ſame rumbe (ſauing onely the rumbe of North and South, which is all one with the

the Meridian) maketh alwaies æquall angles with euery meridian, without either ſenſible, numerable, or mẽſurable, though not without intelligible error (for indeede thoſe angles are leſſe and leſſe as they come nearer to the pole, much like as the angle of a little ſemicircle is leſſe then the angle of a greater ſemicircle) all the rumbes muſt needes bee ſtreight lines; if the meridians be æquidiſtant and right lines by the 27 and 28 prop. 1. *Euclid.*

Secondly the reſpectiue ſituation of any place to other in the Chart (which they commonly call the lying or bearing of one place from another according to the points of the Compaſſe) may moſt eaſily be knowne by the nautical Planiſphære with right lined rumbes and æquidiſtant meridians. For that rumbe from which both places are æquidiſtant ſheweth how thoſe two places lye one from another.

And for theſe two cauſes of ſo great facility, both in the making, and vſing of the mariners Chart with æquidiſtant meridians, and ſtreight-lined rumbes, it ought to be preferred before any other inſtrument heretofore publiſhed to that end for the common vſe of the mariner, at ſea eſpecially. And though the globe be cõmended by ſome as moſt abſolute and perfect for all courſes and climates whatſoeuer: yet for the chargeablenes thereof, troubleſome carriage, ſtowage and tædious vſage for the moſt part in nauigation, following any other courſe ſaue Eaſt or Weſt, North or South: it will for the moſt part bee found vnmeete and comberſome, and nothing ſo fit and readie for the mariners common vſe at ſea as the nauticall planiſphære truely made.

How

Chap. II.

How the former errors may be auoyded.

THese errors notwithstanding they haue beene much complained of by diuers, as namely by *Martine Cortese* in his third booke, and second chapter of the Art of Nauigation, but specially by *Petrus Nonius* in his second booke of Geometrical obseruations, rules, and instruments: And although *Gerardus Mercator* in his vniuersal Mappe of the world seemeth to correct them, by making the distances of the parallels greater and greater towards the poles: yet none of them teacheth any certaine way how to amend such grosse faults, whereby the Mariner may bee deceiued many times an whole point of the Compasse, yea sometimes two or three points and more, in iudging by his ordinarie Chart how one place beareth from another: especially if he saile far northwards, or southwards, whereby we may easily gesse, how indirect a course he shall make to come to the desired hauen, that shall follow so false and erroneous direction with great danger (at the least) many times to lose ship, goods, liues and all.

The fountaine of all the errors aforesaid (the last onely excepted) is in the very foundation and groundworke of the Mariners Chart, that is, in the first Geometricall lineaments thereof: namely, because the meridians are not rightly diuided, (the diuisions being euery where æquall:) nor the parallels

rightly

rightly drawne (hauing in all places the same distances each from other that the meridians haue at the æquinoctial:) Whereas the spaces betwixt the parallels should increase more and more as you goe from the æquinoctial towards either of the poles, which *Martin Cortese* also noteth in his 3 booke and 2 chapter of the Art of Nauigation. But he omitteth that wherein all the difficultie lieth, that is, how much, or in what proportion those spaces should increase. Which, that it may the better bee perceiued, I think it not vnmeete first to shew by what kind of proiection (or extension rather) the nauticall planisphære may not vnfitly bee conceiued to bee geometrically made, after this manner.

Suppose a sphæricall superficies with meridians, parallels, rumbes, and the whole hydrographicall description drawne thereupon, to bee inscribed into a concaue cylinder, their axes agreeing in one.

Let this sphericall superficies swel like a bladder, (whiles it is in blowing) æqually alwayes in euerie part thereof (that is, as much in longitude as in latitude) till it apply, and ioyne it selfe (round about, and all alongst also towardes either pole) vnto the concaue superficies of the cylinder: each parallel vpon this sphæricall superficies increasing successiuely from the æquinoctiall towardes either pole, vntill it come to bee of æquall diameter with the cylinder, and consequently the meridians still widening themselues, til they come to bee so far distant euery where each from other as they are at the æquinoctiall. Thus it may most easily be vnderstood, how a sphæricall superficies may (by extension) be made a cylindricall,

lindricall, and consequently a plaine parallelogram superficies; becausse the superficies of a cylinder is nothing elsse but a plaine parallelogramme wownd about two æquall æquidistant circles that haue one common axtree perpendicular vpon the centers of them both, and the peripheries of each of them æquall to the length of the parallelogramme as the distance betwixt thosse circles, or height of the cylinder is æquall to the breadth thereof. So as the nauticall planisphære may be defined to be nothing elsse but a parallelogramme made of the sphæricall superficies of an Hydrographicall globe inscribed into a concaue cylinder, both their axes concurring in one; and the sphæricall superficies swelling in euery part equally in longitude and latitude, till euery one of the parallels thereupon be inscribed into the cylinder (each parallel growing as great as the æquinoctial:) or till the whole sphæricall superficies, touch and apply it selfe euery where to the concauitie of the cylinder.

The definition of the nauticall planisphære.

In this nauticall planisphære thus conceiued to be made, all places must needes bee situate in the same longitudes, latitudes, and directions or courses, and vpon the same meridians, parallels, and rumbes, that they were in the globe, becausse that at euery poynt betweene the æquinoctiall and the pole, wee vnderstand the sphæricall superficies whereof this planisphære is conceiued to be made, to swell æqually as much in longitude as in latitude (til it ioyne it selfe vnto the concauitie of the cylinder, so as hereby no part thereof is any way distorted or displaced out of his true and naturall situation vpon his meridian, parallel,

rallel, or rumbe, but onely dilated and enlarged, the meridians also, parallels, and rumbes dilating and enlarging themselues likewise, at euery point of latitude in the same proportion.

Now then let vs diligently consider of the Geometricall lineaments, that is, the meridians, rumbs, and parallels of this imaginary nautical planisphære, that we may in like manner expresse the same in the mariners Chart. For so vndoubtedly we shall haue therein a true hydrographicall description of all places, in their longitudes, latitudes, and directions, or respectiue situations each from other according to the points of the Compasse in all things correspondent to the globe, without either sensible, or explicable error.

First therefore in this planisphære, because the parallels are euery where æquall each to other (for euery one of them is æquall to the æquinoctiall or circumference of the circumscribing cylinder) the meridians also must needs be parallel and streight lines: and consequently the rumbs (making æquall angles with euery meridian) must likewise be streight lines. 17. Prop. 1. Euclid 17.

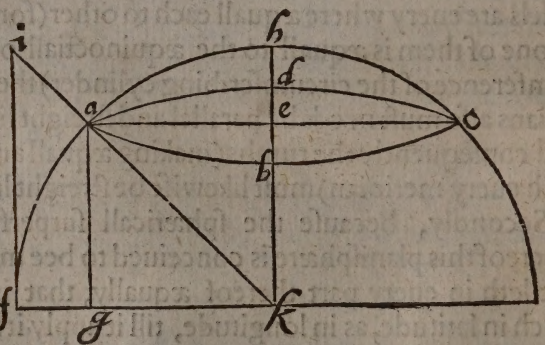
Secondly, because the sphæricall superficies whereof this planisphære is conceiued to bee made, swelleth in euery part thereof æqually; that is, as much in latitude, as in longitude, till it apply itselfe round about, to the concauitie of the cylinder: therefore at euery point of latitude in this planisphære, a part of the meridian keepeth the same proportion to the like part of the parallel, that the like partes of the meridian, and parallel haue each to other in the globe, without any explicable error.

Now

Now becauſe like partes of wholes keepe the ſame proportion that their wholes haue, therefore the like parts of any parallel and meridian of the globe, haue the ſame proportion that the ſame parallel and meridian haue.

For example ſake, as the meridian is double to the parallel of 60 degrees, ſo a degree of the meridian is double to a degree of that parallel, or a minute to a minute &c. and what proportion the parallel hath to the meridian, the ſame proportion haue their diameters and ſemidiameters each to other. 26.18.c.2.e.15 *Rami.*

But the ſine of the complement of the parallels latitude, or diſtance from the æquinoctiall, is the ſemidiameter of the parallel;



As here you ſee, *ae* the ſine of *ah* the complement of *af* the latitude or diſtance of the parallel *a b c d*, from the æquinoctial, is the ſemidiameter of the ſame parallel *a b c d*.

And as the ſemidiameter of the meridian (or the whole

whole ſine) is to the ſemidiameter of the parallel, ſo is the Secans, or Hypotenuſa of the parallels latitude (or of the parallels diſtance from the æquinoctial) to the ſemidiameter of the meridian, or to the whole ſine; as *f k* (that is) *a k*, to *a c* (that is) *g k*; ſo is *i k*, to *k f*.

Therefore in this nautical planiſphære, the ſemidiameter of each parallel being equal to the ſemidiameter of the æquinoctial (that is) to the whole ſine; the parts of the meridian at euery point of latitude muſt needs increaſe with the ſame proportion wherwith the Secantes of the arke, conteyned betweene thoſe points of latitude and the æquinoctial doe increaſe.

Now then we haue an eaſie way laid open for the making of a table (by helpe of the Canon of Triangles) whereby the meridians of the Mariners Chart may moſt eaſily and truly be diuided into parts, in due proportion from the æquinoctial towards either pole.

For (ſuppoſing each diſtance of each point of latitude, or of each parallel from other, to conteine ſo many parts as the Secans of the latitude of each point or parallel conteineth) by perpetuall addition of the Secantes anſwerable to the latitudes of each point or parallel vnto the ſumme compounded of all the former ſecantes, beginning with the ſecans of the firſt parallels latitude, and thereto adding the ſecans of the ſecond parallels latitude, and to the ſumme of both theſe adioyning the ſecans of the third parallels latitude, and ſo forth in all the reſt, we may make a table which ſhall truly ſhew the ſections and points

of latitude in the meridians of the nautical planiſphęre : by which ſections, the parallels are to bee drawne.

As in the table following, we make the diſtance of each parallel from other, to be one minute: and we ſuppoſe the ſpace betweene any two parallels each next to other in the planiſphære to conteine ſo many parts as the ſecans anſwerable to the diſtance of the furtheſt of thoſe two parallels from the æquinoctial, and ſo by perpetual addition of the ſecans of each minute to the ſumme compounded of all the former ſecants, I make the whole table. As for example, the ſecans of one minute is 10,000,000. which alſo ſheweth the ſection of one minute of the meridian from the æquinoctiall in the nauticall planiſphære. Whereunto adde the ſecans of 2. minutes, that is 10,000,002, the ſumme is 20,000,002. which ſheweth the ſection of the ſecond minute of the meridian from the æquinoctial, in the planiſphære : to this ſumme adde the ſecans of 3. minutes, which is 10,000,004, the ſumme will be 30,000,006. which ſheweth the ſection of the third minute of the meridian from the æquinoctial : and ſo forth in all the reſt : ſauing that in this table we haue of purpoſe omitted in euery ſecans the 3 firſt ciphers next the right hand : not only for the eaſier, but alſo for the truer making of the table, becauſe that indeed, at euery point of latitude, a minute of the meridian in this nauticall planiſphære, hath ſomewhat leſſe proportion to a minute of the parallel adioyning towards the æquinoctial, then the ſecans of that parallels latitude hath to the whole ſine. But in this table it

was

was thought ſufficient to vſe ſuch exactnes as that thereby (in drawing the lineaments of the nautical planiſphære) ſenſible error might be auoided. He that liſteth to be more preciſe may make the like table to decades or tennes of ſeconds out of *Ioachimus Rhæticus* his *Canon magnus triangulorum.* Notwithſtanding the Geometriciã that deſireth exact trueth, cannot be ſo ſatisfied neither, for whoſe ſake and further ſatisfaction, I thought good to adioyne alſo this Geometrical conceit of diuiding a meridian of the nautical planiſphære.

Let the æquinoctial and a meridian be drawne vpon a Globe: Let the meridian (diuided into degrees, minutes, ſeconds, &c.) roule vpon a ſtreight line beginning at the æquinoctial, the Globe ſwelling in the meane time in ſuch ſort that the ſemidiameter thereof may be alwaies æqual to the ſecans of the angle, or arch conteined betweene the æquinoctial and ſemidiameter inſiſting at right angles vpon the foreſaid ſtreight line: The degrees, minutes, ſeconds &c. of the meridiã, noted in the ſtreight line, as they come to touch the ſame, are the diuiſions of the meridian in the nautical planiſphære. And this conceit of diuiding the meridian of the nautical planiſphære may ſatisfie the curious exactnes of the Geometrician: but for mechanical vſe, the table before mentioned (which heere now followeth) may ſuffice.

This Table (ſeruing principally for the true diuiding of the meridians of the Sea Chart, in ſuch ſort that in any part thereof, a minute of the meridian, ſhall haue the ſame proportion to a minute of the

parallel thereto adioyning that it hath in the globe) may not vnfitly be called, *A Table of Latitudes.*

For as in Geographie, the latitude of a place is nothing els but the ſhorteſt diſtance thereof from the æquinoctial line, meaſured vpon the conuexitie of the earth or ſea in degrees and minutes; and therefore Tables containing ſuch diſtances are ordinarily called tables of latitudes: So this Table, ſhewing the diſtance of euery minute of a meridian in the Sea Chart from the æquinoctiall line thereof towards the North or South, in ſuch equal parts whereof one minute of the æquinoctial is ſuppoſed to containe 10,000, may with like reaſon, by a certaine analogie, and reſemblance it holdeth with the foreſaid tables, be very well called, *A Table of Latitudes of euery minute of a meridian of the Sea Chart, in ſuch parts whereof each minute of the æquinoctial containeth* 10,000.

This Table is diuided into three columnes; whereof the firſt containeth, in the head thereof the degrees, and in the reſt of that columne, minutes of a meridian of the nauticall planiſphære, beginning at the æquinoctial line. In the ſecond columne are placed equal parts of the ſame meridian, beginning likewiſe to be numbred from the æquinoctial (of which parts each minute of the æquinoctial is ſuppoſed to containe 10,000) and ſheweth how many of theſe parts each minute of latitude in the Sea Chart muſt be diſtant from the æquinoctiall. The third columne ſheweth the differences of the numbers ſet downe in the ſecond columne.

The vſe hereof followeth after this Table.

or Meridional parts

0 Degr.			0 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	00,000		30	300,000	
1	10,000	10,000	31	310,000	10,000
2	20,000	10,000	32	320,000	10,000
3	30,000	10,000	33	330,000	10,000
4	40,000	10,000	34	340,000	10,000
5	50,000	10,000	35	350,000	10,000
6	60,000	10,000	36	360,000	10,000
7	70,000	10,000	37	370,000	10,000
8	80,000	10,000	38	380,000	10,000
9	90,000	10,000	39	390,000	10,000
10	100,000	10,000	40	400,000	10,000
11	110,000	10,000	41	410,000	10,000
12	120,000	10,000	42	420,000	10,000
13	130,000	10,000	43	430,000	10,000
14	140,000	10,000	44	440,000	10,000
15	150,000	10,000	45	450,000	10,000
16	160,000	10,000	46	460,000	10,000
17	170,000	10,000	47	470,000	10,000
18	180,000	10,000	48	480,000	10,001
19	190,000	10,000	49	490,001	10,001
20	200,000	10,000	50	500,002	10,001
21	210,000	10,000	51	510,003	10,001
22	220,000	10,000	52	520,004	10,001
23	230,000	10,000	53	530,005	10,001
24	240,000	10,000	54	540,006	10,001
25	250,000	10,000	55	550,007	10,001
26	260,000	10,000	56	560,008	10,001
27	270,000	10,000	57	570,009	10,001
28	280,000	10,000	58	580,010	10,001
29	290,000	10,000	59	590,011	10,001
30	300,000		60	600,012	

1 Degr.			1 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	600,012		30	900,070	
1	610,013	10,001	31	910,073	10,003
2	620,014	10,001	32	920,076	10,003
3	630,015	10,001	33	930,079	10,003
4	640,016	10,001	34	940,082	10,003
5	650,017	10,001	35	950,085	10,003
6	660,018	10,001	36	960,088	10,003
7	670,019	10,001	37	970,091	10,004
8	680,020	10,002	38	980,095	10,004
9	690,022	10,002	39	990,099	10,004
10	700,024	10,002	40	1,000,103	10,004
11	710,026	10,002	41	1,010,107	10,004
12	720,028	10,002	42	1,020,111	10,004
13	730,030	10,002	43	1,030,115	10,004
14	740,032	10,002	44	1,040,119	10,004
15	750,034	10,002	45	1,050,123	10,004
16	760,036	10,002	46	1,060,127	10,004
17	770,038	10,002	47	1,070,131	10,004
18	780,040	10,002	48	1,080,135	10,005
19	790,042	10,002	49	1,090,140	10,005
20	800,044	10,002	50	1,100,145	10,005
21	810,046	10,002	51	1,110,150	10,005
22	820,048	10,002	52	1,120,155	10,005
23	830,050	10,062	53	1,130,160	10,005
24	840,052	10,003	54	1,140,165	10,005
25	850,055	10,003	55	1,150,170	10,005
26	860,058	10,003	56	1,160,175	10,005
27	870,061	10,003	57	1,170,180	10,005
28	880,064	10,003	58	1,180,185	10,005
29	890,067	10,003	59	1,190,190	10,006
30	900,070		60	1,200,196	

2 Degr.			2 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	1,200,196		30	1,500,416	
1	1,210,202	10,006	31	1,510,425	10,009
2	1,220,208	10,006	32	1,520,434	10,009
3	1,230,214	10,006	33	1,530,443	10,009
4	1,240,220	10,006	34	1,540,453	10,010
5	1,250,226	10,006	35	1,550,463	10,010
6	1,260,232	10,006	36	1,560,473	10,010
7	1,270,238	10,006	37	1,570,483	10,010
8	1,280,244	10,007	38	1,580,493	10,010
9	1,290,251	10,007	39	1,590,503	10,010
10	1,300,258	10,007	40	1,600,513	10,010
11	1,310,265	10,007	41	1,610,523	10,011
12	1,320,272	10,007	42	1,620,534	10,011
13	1,330,279	10,007	43	1,630,545	10,011
14	1,340,286	10,007	44	1,640,556	10,011
15	1,350,293	10,007	45	1,650,567	10,011
16	1,360,300	10,007	46	1,660,578	10,011
17	1,370,307	10,008	47	1,670,589	10,011
18	1,380,315	10,008	48	1,680,600	10,012
19	1,390,323	10,008	49	1,690,612	10,012
20	1,400,331	10,008	50	1,700,624	10,012
21	1,410,339	10,008	51	1,710,636	10,012
22	1,420,347	10,008	52	1,720,648	10,012
23	1,430,355	10,008	53	1,730,660	10,012
24	1,440,363	10,008	54	1,740,672	10,012
25	1,450,371	10,009	55	1,750,684	10,013
26	1,460,380	10,009	56	1,760,697	10,013
27	1,470,389	10,009	57	1,770,710	10,013
28	1,480,398	10,009	58	1,780,723	10,013
29	1,490,407	10,009	59	1,790,736	10,013
30	1,500,416		60	1,800,749	

3 Degr.			3 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	1,800,749		30	2,101,220	
		10,013			10,018
1	1,810,762		31	2,111,238	
		10,014			10,019
2	1,820,776		32	2,121,257	
		10,014			10,019
3	1,830,790		33	2,131,276	
		10,014			10,019
4	1,840,804		34	2,141,295	
		10,014			10,019
5	1,850,818		35	2,151,314	
		10,014			10,019
6	1,860,832		36	2,161,333	
		10,014			10,019
7	1,870,846		37	2,171,352	
		10,014			10,020
8	1,888,860		38	2,181,372	
		10,015			10,020
9	1,890,875		39	2,191,392	
		10,015			10,020
10	1,900,890		40	2,201,412	
		10,015			10,020
11	1,910,905		41	2,211,432	
		10,015			10,020
12	1,920,920		42	2,221,452	
		10,015			10,021
13	1,930,935		43	2,231,473	
		10,015			10,021
14	1,940,950		44	2,241,494	
		10,016			10,021
15	1,950,966		45	2,251,515	
		10,016			10,021
16	1,960,982		46	2,261,536	
		10,016			30,021
17	1,970,998		47	2,271,557	
		10,016			10,022
18	1,981,014		48	2,281,579	
		10,016			10,022
19	1,991,030		49	2,291,601	
		10,016			10,022
20	2,001,046		50	2,301,623	
		10,017			10,022
21	2,011,063		51	2,311,645	
		10,017			10,022
22	2,021,080		52	2,321,667	
		10,017			10,023
23	2,031,097		53	2,331,690	
		10,017			10,023
24	2,041,114		54	2,341,713	
		10,017			10,023
25	2,051,131		55	2,351,736	
		10,017			10,023
26	2,061,148		56	2,361,759	
		10,018			10,023
27	2,071,166		57	2,371,782	
		10,018			10,024
28	2,081,184		58	2,381,806	
		10,018			10,024
29	2,091,202		59	2,391,830	
		10,018			10,024
30	2,101,220		60	2,401,854	

4 Degr.			4 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	2,401,854		30	2,702,671	
		10,024			10,031
1	2,411,878		31	2,712,702	
		10,024			10,031
2	2,421,902		32	2,722,733	
		10,025			10,031
3	2,431,927		33	2,732,764	
		10,025			10,031
4	2,441,952		34	2,742,795	
		10,025			10,032
5	2,451,977		35	2,752,827	
		10,025			10,032
6	2,462,002		36	2,762,859	
		10,025			10,032
7	2,472,027		37	2,772,891	
		10,026			10,032
8	2,482,053		38	2,782,923	
		10,026			10,033
9	2,492,079		39	2,792,956	
		10,026			10,033
10	2,502,105		40	2,802,989	
		10,026			10,033
11	2,512,131		41	2,813,022	
		10,026			10,033
12	2,522,157		42	2,823,055	
		10,027			10,033
13	2,532,184		43	2,833,088	
		10,027			10,034
14	2,542,211		44	2,843,122	
		10,027			10,034
15	2,552,238		45	2,853,156	
		10,027			10,034
16	2,562,265		46	2,863,190	
		10,028			10,034
17	2,572,293		47	2,873,224	
		10,028			10,035
18	2,582,321		48	2,883,259	
		10,028			10,035
19	2,592,349		49	2,893,294	
		10,028			10,035
20	2,602,377		50	2,903,329	
		10,028			10,035
21	2,612,405		51	2,913,364	
		10,029			10,036
22	2,622,434		52	2,923,400	
		10,029			10,036
23	2,632,463		53	2,933,436	
		10,029			10,036
24	2,642,492		54	2,943,472	
		10,029			10,036
25	2,652,521		55	2,953,508	
		10,030			10,037
26	2,662,551		56	2,963,545	
		10,030			10,037
27	2,672,581		57	2,973,582	
		10,030			10,037
28	2,682,611		58	2,983,619	
		10,030			10,037
29	2,692,641		59	2,993,656	
		10,030			10,038
30	2,702,671		60	3,003,694	

5 Degr.			15 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	3,003,694		30	3,304,948	
		10,038			10,046
1	3,013,732		31	3,314,994	
		10,038			10,046
2	3,023,770		32	3,325,040	
		10,038			10,047
3	3,033,808		33	3,335,087	
		10,039			10,047
4	3,043,847		34	3,345,134	
		10,039			10,047
5	3,053,886		35	3,355,181	
		10,039			10,047
6	3,063,925		36	3,365,228	
		10,040			10,048
7	3,073,965		37	3,375,276	
		10,040			10,048
8	3,084,005		38	3,385,324	
		10,040			10,048
9	3,094,045		39	3,395,372	
		10,040			10,049
10	3,104,085		40	3,405,421	
		10,041			10,049
11	3,114,126		41	3,415,470	
		10,041			10,049
12	3,124,167		42	3,425,519	
		10,041			10,049
13	3,134,208		43	3,435,568	
		10,041			10,050
14	3,144,249		44	3,445,618	
		10,042			10,050
15	3,154,291		45	3,455,668	
		10,042			10,050
16	3,164,333		46	3,465,718	
		10,042			10,051
17	3,174,375		47	3,475,769	
		10.042			10,051
18	3,184,417		48	3,485,820	
		10,043			10,051
19	3,194,460		49	3,495,871	
		10,043			10,052
20	3,204,503		50	3,505,923	
		10,043			10,052
21	3,214,546		51	3,515,975	
		10,044			10,052
22	3,224,590		52	3,526,027	
		10,044			10,052
23	3,234,634		53	3,536,079	
		10.044			10,053
24	3,244,678		54	3,546,132	
		10,044			10,053
25	3,254,722		55	3,556,185	
		10,045			10,053
26	3,264,767		56	3,566,238	
		10 045			10,054
27	3,274,812		57	3,576,292	
		10,045			10,054
28	3,284,857		58	3,586,346	
		10.045			10,054
29	3,294,902		59	3,596,400	
		10,046			10,055
30	3,304,948		60	3,606,455	

6 Degr.			6 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	3,606,455		30	3,908,241	
		10,055			10,065
1	3,616,510		31	3,918,306	
		10,055			10,065
2	3,626,565		32	3,928,371	
		10,056			10,065
3	3,636,621		33	3,938,436	
		10,056			10,066
4	3,646,677		34	3,948,502	
		10,056			10,066
5	3,656,733		35	3,958,568	
		10,056			10,066
6	3,666,789		36	3,968,634	
		10,057			10,067
7	3,676,846		37	3,978,701	
		10,057			10,067
8	3,686,903		38	3,988,768	
		10,057			10,067
9	3,696,960		39	3,998,835	
		10,058			10,068
10	3,707,018		40	4,008,903	
		10,058			10,068
11	3,717,076		41	4,018,971	
		10,058			10,068
12	3,727,134		42	4,029,039	
		10,059			10,069
13	3,737,193		43	4,039,108	
		10,059			10,069
14	3,747,252		44	4,049,177	
		10,059			10,069
15	3,757,311		45	4,059,246	
		10,060			10,070
16	3,767,371		46	4,069,316	
		10,060			10,070
17	3,777,431		47	4,079,386	
		10,060			10,070
18	3,787,491		48	4,089,456	
		10,061			10,071
19	3,797,552		49	4,099,527	
		10,061			10,071
20	3,807,613		50	4,109,598	
		10,061			10,071
21	3,817,674		51	4,119,669	
		10,062			10,072
22	3,827,736		52	4,129,741	
		10,062			10,072
23	3,837,798		53	4,139,813	
		10,062			10,072
24	3,847,860		54	4,149,885	
		10,063			10,073
25	3,857,923		55	4,159,958	
		10,063			10,073
26	3,867,986		56	4,170,031	
		10,063			10,074
27	3,878,049		57	4,180,105	
		10,064			10,074
28	3,888,113		58	4,190,179	
		10,064			10,074
29	3,898,177		59	4,200,253	
		10,064			10,075
30	3,908,241		60	4,210,328	

Min.	7 Degr. Equal parts of a meridian, &c.	Difference of equal parts.	Min.	7 Degr. Equal parts of a meridian, &c.	Difference of equal parts.
0	4,210,328		30	4,512,737	
		10,075			10,086
1	4,220,403		31	4,122,823	
		10,075			10,087
2	4,230,478		32	4,532,910	
		10,076			10,087
3	4,240,554		33	4,542,997	
		10,076			10,087
4	4,250,630		34	4,553,084	
		10,076			10,088
5	4,260,706		35	4,563,172	
		10,077			10,088
6	4,270,783		36	4,573,260	
		10,077			10,089
7	4,280,860		37	4,583,349	
		10,078			10,089
8	4,290,938		38	4,593,438	
		10,078			10,089
9	4,301,016		39	4,603,527	
		10,078			10,090
10	4,311,094		40	4,613,617	
		10,079			10,090
11	4,321,173		41	4,623,707	
		10,079			10,090
12	4,331,252		42	4,633,797	
		10,079			10,091
13	4,341,331		43	4,643,888	
		10,080			10,091
14	4,351,411		44	4,653,979	
		10,080			10,092
15	4,361,491		45	4,664,071	
		10,080			10,092
16	4,371,571		46	4,674,136	
		10,081			10,092
17	4,381,652		47	4,684,228	
		10,081			10,093
18	4,391,733		48	4,694,321	
		10,082			10,093
19	4,401,815		49	4,704,414	
		10,082			10,094
20	4,411,897		50	4,714,508	
		10,082			10,094
21	4,421,979		51	4,724,602	
		10,083			10,095
22	4,432,062		52	4,734,697	
		10,083			10,095
23	4,442,145		53	4,744,792	
		10,083			10,095
24	4,452,228		54	4,754,887	
		10,084			10,096
25	4,462,312		55	4,764,983	
		10,084			10,096
26	4,472,396		56	4,775,079	
		10,085			10,097
27	4,482,481		57	4,785,176	
		10,085			10,097
28	4,492,566		58	4,795,273	
		10,085			10,097
29	4,502,651		59	4,805,370	
		10,086			10,098
30	4,512,737		60	4,815,468	

8 Degr.			8 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	4,815,468		30	5,118,598	
		10,098			10,111
1	4,825,566		31	5,128,709	
		10,099			10,111
2	4,835,665		32	5,138,820	
		10,099			10,112
3	4,845,764		33	5,148,932	
		10,099			10,112
4	4,855,863		34	5,159,044	
		10,100			10,113
5	4,865,963		35	5,169,157	
		10,100			10,113
6	4,876,063		36	5,179,270	
		10,101			10,114
7	4,886,164		37	5,189,384	
		10,101			10,114
8	4,896,265		38	5,199,498	
		10,102			10,115
9	4,906,367		39	5,209,613	
		10,102			10,115
10	4,916,469		40	5,219,728	
		10,102			10,115
11	4,926,571		41	5,229,843	
		10,103			10,116
12	4,936,674		42	5,239,959	
		10,103			10,116
13	4,946,777		43	5,250,075	
		10,104			10,117
14	4,956,881		44	5,260,193	
		10,104			10,117
15	4,966,985		45	5,270,309	
		10,104			10,118
16	4,977,089		46	5,280,427	
		10,105			10,118
17	4,987,194		47	5,290,545	
		10,105			10,119
18	4,997,299		48	5,300,664	
		10,106			10,119
19	5,007,405		49	5,310,783	
		10,106			10,120
20	5,017,511		50	5,320,903	
		10,107			10,120
21	5,027,618		51	5,331,023	
		10,107			10,120
22	5,037,725		52	5,341,143	
		10,108			10,121
23	5,047,833		53	5,351,264	
		10,108			10,121
24	5,057,941		54	5,361,385	
		10,108			10,122
25	5,068,049		55	5,371,507	
		10,109			10,122
26	5,078,158		56	5,381,629	
		10,109			10,123
27	5,088,267		57	5,391,752	
		10,110			10,123
28	5,098,377		58	5,401,875	
		10,110			10,124
29	5,108,487		59	5,411,999	
		10,111			10,124
30	5,118,598		60	5,422,123	

9 Degr.			9 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	5,422,133	10,125	30	5,726,080	10,139
1	5,432,258	10,125	31	5,736,219	10,140
2	5,442,383	10,126	32	5,746,359	10,140
3	5,452,509	10,126	33	5,756,499	10,141
4	5,462,635	10,126	34	5,766,640	10,141
5	5,472,761	10,127	35	5,776,781	10,142
6	5,482,888	10,127	36	5,786,923	10,142
7	5,493,015	10,128	37	5,797,065	10,143
8	5,503,143	10,128	38	5,807,208	10,143
9	5 513,271	10,129	39	5,817,351	10,144
10	5,523,400	10,129	40	5,827,495	10,144
11	5,533,529	10,130	41	5,837,639	10,145
12	5,543,659	10,130	42	5,847,784	10,145
13	5,553,789	10,131	43	5,857,929	10,146
14	5,563,920	10,131	44	5,868,075	10,146
15	5,574,051	10,132	45	5,878,221	10,147
16	5,584,183	10,132	46	5,888,368	10,147
17	5,594,315	10,133	47	5,898,515	10,148
18	5,604,448	10,133	48	5,908,663	10,148
19	5,614,581	10,134	49	5,918,811	10,149
20	5,624,715	10,134	50	5,928,960	10,149
21	5,634,849	10,135	51	5,939,109	10,150
22	5,644,984	10,135	52	5,949,259	10,150
23	5,655,119	10,136	53	5,959,409	10,151
24	5,665,255	10,136	54	5,969,560	10,151
25	5,675,391	10,137	55	5,979,711	10,152
26	5,685,528	10,137	56	5,989,863	10,152
27	5,695,665	10,138	57	6,000,015	10,153
28	5,705,803	10,138	58	6,010,168	10,153
29	5,715,941	10,139	59	6,020,321	10,154
30	5,726,080		60	6,030,475	

10 Degr.			10 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	6,030,475		30	6,335,335	
		10,154			10,170
1	6,040,629		31	6,345,505	
		10,155			10,171
2	6,050,784		32	6,355,676	
		10,155			10,171
3	6,060,939		33	6,365,847	
		10,156			10,172
4	6,071,095		34	6,376,019	
		10,156			10,173
5	6,081,251		35	6,386,192	
		10,157			10,173
6	6,091,408		36	6,396,365	
		10,157			10,174
7	6,101,565		37	6,406,539	
		10,158			10,174
8	6,111,723		38	6,416,713	
		10,158			10,175
9	6,121,881		39	6,426,888	
		10,159			10,175
10	6,132,040		40	6,437,063	
		10,160			10,176
11	6,142,200		41	6,447,239	
		10,160			10,176
12	6,152,360		42	6,457,415	
		10,161			10,177
13	6,162,521		43	6,467,592	
		10,161			10,178
14	6,172,682		44	6,477,770	
		10,162			10,178
15	6,182,844		45	6,487,948	
		10,162			10,179
16	6,193,006		46	6,498,127	
		30,163			10,179
17	6,203,169		47	6,508,306	
		10,163			10,180
18	6,213,332		48	6,518,486	
		10,164			10,180
19	6,223,496		49	6,528,666	
		10,165			10,181
20	6,233,661		50	6,538,847	
		10,165			10,182
21	6,243,826		51	6,549,029	
		10,165			10,182
22	6,253,991		52	6,559,211	
		10,166			10,183
23	6,264,157		53	6,569,394	
		10,167			10,183
24	6,274,324		54	6,579,577	
		10,167			10,184
25	6,284,491		55	6,589,761	
		10,168			10,184
26	6,294,659		56	6,599,945	
		10,168			10,185
27	6,304,827		57	6,610,130	
		10,169			10,186
28	6,314,996		58	6,620,316	
		10,169			10,186
29	6,325,165		59	6,630,502	
		10,170			10,187
30	6,335,335		60	6,640,689	

11 Degr.			11 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	6,640,679		30	6,946,551	
		10,187			10,205
1	6,650,866	10,188	31	6,956,756	10,206
2	6,661,054	10,188	32	6,966,962	10,206
3	6,671,242		33	6,977,168	
		10,189			10,207
4	6,681,431	10,190	34	6,987,375	10,207
5	6,691,621	10,190	35	6,997,582	10,208
6	6,701,811		36	7,007,790	
		10,191			10,209
7	6,712,002	10,191	37	7,017,999	10,209
8	6,722,219	10,192	38	7,028,208	10,210
9	6,732,385		39	7,038,418	
		10,192			10,210
10	6,742,577	10,193	40	7,048,628	10,211
11	6,752,770	10,194	41	7,058,839	10,212
12	6,762,964		42	7,069,051	
		10,194			10,212
13	6,773,158	10,195	43	7,079,263	10,213
14	6,783,353	10,195	44	7,089,476	10,214
15	6,793,548		45	7,099,690	
		10,196			10,214
16	6,803,744	10,197	46	7,109,904	10,215
17	6,813,941	10,197	47	7,120,119	10,215
18	6,824,138		48	7,130,334	
		10,198			10,216
19	6,834,336	10,198	49	7,140,550	10,217
20	6,844,534	10,199	50	7,150,767	10,217
21	6,854,733		51	7,160,984	
		10,200			10,218
22	6,864,933	10,200	52	7,171,202	10,219
23	6,875,133	10,201	53	7,181,421	10,219
24	6,885,334		54	7,191,640	
		10,201			10,220
25	6,895,535	10,202	55	7,201,860	10,220
26	6,905,737	10,203	56	7,212,080	10,221
27	6,915,940		57	7,222,301	
		10,203			10,222
28	6,926,143	10,204	58	7,232,323	10,222
29	6,936,347	10,204	59	7,242,745	10,223
30	6,946,551		60	7,252,968	

12 Degr.			12 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	7,252,968		30	7,559,953	
		10,224			10,243
1	7,263,192		31	7,570,196	
		10,224			10,244
2	7,273,416		32	7,580,440	
		10,225			10,244
3	7,283,641		33	7,590,684	
		10,225			10,245
4	7,293,866		34	7,600,929	
		10,226			10,246
5	7,304,092		35	7,611,175	
		10,227			10,246
6	7,314,319		36	7,621,421	
		10,227			10,247
7	7,324,546		37	7,631,668	
		10,228			10,248
8	7,334,774		38	7,641,916	
		10,229			10,248
9	7,345,003		39	7,652,164	
		10,229			10,249
10	7,355,232		40	7,662,413	
		10,230			10,250
11	7,365,462		41	7,672,663	
		10,231			10,250
12	7,375,693		42	7,682,913	
		10,231			10,251
13	7,385,924		43	7,693,164	
		10,232			10,252
14	7,396,156		44	7,703,416	
		10,232			10,252
15	7,406,388		45	7,713,668	
		10,233			10,253
16	7,416,621		46	7,723,921	
		10,234			10,254
17	7,426,855		47	7,734,175	
		10,234			10,254
18	7,437,089		48	7,744,429	
		10,235			10,255
19	7,447,324		49	7,754,684	
		10,236			10,256
20	7,457,560		50	7,764,940	
		10,236			10,256
21	7,467,796		51	7,775,196	
		10,237			10,257
22	7,478,033		52	7,785,453	
		10,238			10,258
23	7,488,271		53	7,795,711	
		10,238			10,258
24	7,498,509		54	7,805,969	
		10,239			10,259
25	7,508,748		55	7,816,228	
		10,240			10,260
26	7,518,988		56	7,826,488	
		10,240			10,260
27	7,529,228		57	7,836,748	
		10,241			10,261
28	7,539,469		58	7,847,009	
		10,242			10,262
29	7,549,711		59	7,857,271	
		10,242			10,263
30	7,559,953		60	7,867,534	

13 Degr.			13 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	7,867,534		30	8,175,736	
		10,263			10,284
1	7,877,797	10,264	31	8,186,020	10,285
2	7,888,061	10,265	32	8,196,305	10,286
3	7,898,326		33	8,206,591	
		10,265			10,287
4	7,908,591	10,266	34	8,216,878	10,287
5	7,918,857	10,267	35	8,227,165	10,288
6	7,929,124		36	8,237,453	
		10,267			10,289
7	7,939,391	10,268	37	8,247,742	10,289
8	7,949,659	10,269	38	8,258,031	10,290
9	7,959,928		39	8,268,321	
		10,269			10,291
10	7,970,197	10,270	40	8,278,612	10,292
11	7,980,467	10,271	41	8,288,904	10,292
12	7,990,738		42	8,299,196	
		10,272			10,293
13	8,001,010	10,272	43	8,309,489	10,294
14	8,011,282	10,273	44	8,319,783	10,295
15	8,021,555		45	8,330,078	
		10,274			10,295
16	8,031,829	10,274	46	8,340,373	10,296
17	8,042,103	10,275	47	8,350,669	10,297
18	8,052,378		48	8,360,966	
		10,276			10,297
19	8,062,654	10,277	49	8,371,263	10,298
20	8,072,931	10,277	50	8,381,561	10,299
21	8,083,208		51	8,391,860	
		10,278			10,300
22	8,093,486	10,279	52	8,402,160	10,300
23	8,103,765	10,279	53	8,412,460	10,301
24	8,114,044		54	8,422,761	
		10,280			10,302
25	8,124,324	10,281	55	8,433,063	10,303
26	8,134,605	10,282	56	8,443,366	10,303
27	8,144,887		57	8,453,669	
		10,282			10,304
28	8,155,169	10,283	58	8,463,973	10,305
29	8,165,452	10,284	59	8,474,278	10,306
30	8,175,736		60	8,484,584	

14 Degr.			14 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	8,484,584		30	8,794,105	
		10,306			10,329
1	8,494,890		31	8,804,434	
		10,307			10,330
2	8,505,197		32	8,814,764	
		10,308			10,331
3	8,515,505		33	8,825,095	
		10,309			10,332
4	8,525,814		34	8,835,427	
		10,309			10,332
5	8,536,123		35	8,845,759	
		10,310			10,333
6	8,546,433		36	8,856,092	
		10,311			10,334
7	8,556,744		37	8,866,426	
		10,312			10,335
8	8,567,056		38	8,876,761	
		10,312			10,336
9	8,577,368		39	8,887,097	
		10,313			10,336
10	8,587,681		40	8,897,433	
		10,314			10,337
11	8,597,995		41	8,907,770	
		10,315			10,338
12	8,608,310		42	8,918,108	
		10,315			10,339
13	8,618,625		43	8,928,447	
		10,316			10,339
14	8,628,941		44	8,938,786	
		10,317			10,340
15	8,639,258		45	8,949,126	
		10,318			10,341
16	8,649,576		46	8,959,467	
		10,318			10,342
17	8,659,894		47	8,969,809	
		10,319			10,343
18	8,670,213		48	8,980,152	
		10,320			10,343
19	8,680,533		49	8,990,495	
		10,321			10,344
20	8,690,854		50	9,000,839	
		10,322			10,345
21	8,701,176		51	9,011,184	
		10,322			10,346
22	8,711,498		52	9,021,530	
		10,323			10,347
23	8,721,821		53	9,031,877	
		10,324			10,347
24	8,732,145		54	9,042,224	
		10,325			10,348
25	8,742,470		55	9,052,572	
		10,325			10,349
26	8,752,795		56	9,062,921	
		10,326			10,350
27	8,763,121		57	9,073,271	
		10,327			10,351
28	8,773,448		58	9,083,622	
		10,328			10,351
29	8,783,776		59	9,093,973	
		10,329			10,352
30	8,794,105		60	9,104,325	

15 Degr.			15 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	9,104,325		30	9,415,272	
1	9,114,678	10,353	31	9,425,650	10,378
2	9,125,032	10,354	32	9,436,029	10,379
3	9,135,387	10,355	33	9,446,408	10,379
4	9,145,742	10,355	34	9,456,788	10,380
5	9,156,098	10,356	35	9,467,169	10,381
6	9,166,455	10,357	36	9,477,551	10,382
7	9,176,813	10,358	37	9,487,934	10,383
8	9,187,172	10,359	38	9,498,318	10,384
9	9,197,532	10,360	39	9,508,702	10,384
10	9,207,892	10,360	40	9,519,087	10,385
11	9,218,253	10,361	41	9,529,473	10,386
12	9,228,615	10,362	42	9,539,860	10,387
13	9,238,978	10,363	43	9,550,248	10,388
14	9,249,342	10,364	44	9,560,637	10,389
15	9,259,706	10,364	45	9,571,027	10,390
16	9,270,071	10,365	46	9,581,417	10,390
17	9,280,437	10,366	47	9,591,808	10,391
18	9,290,804	10,367	48	9,602,200	10,392
19	9,301,172	10,368	49	9,612,593	10,393
20	9,311,541	10,369	50	9,622,987	10,394
21	9,321,910	10,369	51	9,633,382	10,395
22	9,332,280	10,370	52	9,643,778	10,396
23	9,342,651	10,371	53	9,654,174	10,396
24	9,353,023	10,372	54	9,664,571	10,397
25	9,363,396	10,373	55	9,674,969	10,398
26	9,373,770	10,374	56	9,685,368	10,399
27	9,384,144	10,374	57	9,695,768	10,400
28	9,394,519	10,375	58	9,706,169	10,401
29	9,404,895	10,376	59	9,716,571	10,402
30	9,415,272	10,377	60	9,726,973	10,402

16 Degr.			16 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	9,726,973		30	10,039,456	
		10,403			10,430
1	9,737,376		31	10,049,886	
		10,404			10,431
2	9,747,780		32	10,060,317	
		10,405			10,432
3	9,758,185		33	10,070,749	
		10,406			10,433
4	9,768,591		34	10,081,182	
		10,407			10,433
5	9,778,998		35	10,091,615	
		10,408			10,434
6	9,789,406		36	10,102,049	
		10,409			10,435
7	9,799,815		37	10,112,484	
		10,409			10,436
8	9,810,224		38	10,122,920	
		10,410			10,437
9	9,820,634		39	10,133,357	
		10,411			10,438
10	9,831,045		40	10,143,795	
		10,412			10,439
11	9,841,457		41	10,154,234	
		10,413			10,440
12	9,851,870		42	10,164,674	
		10,414			10,441
13	9,862,284		43	10,175,115	
		10,415			10,442
14	9,872,699		44	10,185,557	
		10,416			10,443
15	9,883,115		45	10,196,000	
		10,417			10,443
16	9,893,532		46	10,206,443	
		10,417			10,444
17	9,903,949		47	10,216,887	
		10,418			10,445
18	9,914,367		48	10,227,332	
		10,419			10,446
19	9,924,786		49	10,237,778	
		10,420			10,447
20	9,935,206		50	10,248,225	
		10,421			10,448
21	9,945,627		51	10,258,673	
		10,422			10,449
22	9,956,049		52	10,269,122	
		10,423			10,450
23	9,966,472		53	10,279,572	
		10,424			10,451
24	9,976,896		54	10,290,023	
		10,425			10,452
25	9,987,321		55	10,300,475	
		10,425			10,453
26	9,997,746		56	10,310,928	
		10,426			10,454
27	10,008,172		57	10,321,382	
		10,427			10,455
28	10,018,599		58	10,331,837	
		10,428			10,455
29	10,029,027		59	10,342,292	
		10,429			10,456
30	10,039,456		60	10,352,748	

17 Degr.			17 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of qual parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	10,352,748		30	10,666,877	
		10,457			10,486
1	10,363,205	10,458	31	10,677,363	10,487
2	10,373,663	10,459	32	10,687,850	10,488
3	10,384,122		33	10,698,338	
		10,460			10,489
4	10,394,582	10,461	34	10,708,827	10,490
5	10,405,043	10,462	35	10,719,317	10,491
6	10,415,505		36	10,729,808	
		10,463			10,492
7	10,425,968	10,464	37	10,740,300	10,493
8	10,436,432	10,465	38	10,750,793	10,493
9	10,446,897		39	10,761,286	
		10,466			10,494
10	10,457,363	10,467	40	10,771,780	10,495
11	10,467,830	10,468	41	10,782,275	10,496
12	10,478,298		42	10,792,771	
		10,469			10,497
13	10,488,767	10,470	43	10,803,268	10,498
14	10,499,237	10,470	44	10,813,766	10,499
15	10,509,707		45	10,824,265	
		10,471			10,500
16	10,520,178	10,472	46	10,834,765	10,501
17	10,530,650	10,473	47	10,845,266	10,502
18	10,541,123		48	10,855,768	
		10,474			10,503
19	10,551,597	10,475	49	10,866,271	10,504
20	10,562,072	10,476	50	10,876,775	10,505
21	10,572,548		51	10,887,280	
		10,477			10,506
22	10,583,025	10,478	52	10,897,786	10,507
23	10,593,503	10,479	53	10,908,293	10,508
24	10,603,982		54	10,918,801	
		10,480			10,509
25	10,614,462	10,481	55	10,929,310	10,510
26	10,624,943	10,482	56	10,939,820	10,511
27	10,635,425		57	10,950,331	
		10,483			10,512
28	10,645,908	10,484	58	10,960,843	10,513
29	10,656,392	10,485	59	10,971,356	10,514
30	10,666,877		60	10,981,870	

18 Degr.			18 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	10,981,870		30	11,297,753	
		10,515			10,545
1	10,992,383	10,516	31	11,308,298	10,546
2	11,002,899	10,517	32	11,318,844	10,548
3	11,013,416		33	11,329,392	
		10,518			10,549
4	11,023,934	10,519	34	11,339,941	10,550
5	11,034,453	10,520	35	11,350,491	10,551
6	11,044,973		36	11,361,042	
		10,521			10,552
7	11,055,494	10,522	37	11,371,594	10,553
8	11,066,016	10,523	38	11,382,147	10,554
9	11,076,539		39	11,392,701	
		10,524			10,555
10	11,087,063	10,525	40	11,403,256	10,556
11	11,097,588	10,526	41	11,413,812	10,557
12	11,108,114		42	11,424,369	
		10,527			10,558
13	11,118,641	10,528	43	11,434,927	10,559
14	11,129,169	10,529	44	11,445,486	10,560
15	11,139,698		45	11,456,046	
		10,530			10,561
16	11,150,228	10,531	46	11,466,607	10,562
17	11,160,759	10,532	47	11,477,169	10,563
18	11,171,291		48	11,487,732	
		10,533			10,564
19	11,181,824	10,534	49	11,498,296	10,565
20	11,192,358	10,535	50	11,508,861	10,566
21	11,202,893		51	11,519,427	
		10,536			10,567
22	11,213,429	10,537	52	11,529,994	10,568
23	11,223,966	10,538	53	11,540,562	10,569
24	11,234,504		54	11,551,131	
		10,539			10,570
25	11,245,043	10,540	55	11,561,701	10,571
26	11,255,583	10,541	56	11,572,272	10,573
27	11,266,124		57	11,582,845	
		10,542			10,574
28	11,276,666	10,543	58	11,593,419	10,575
29	11,287,209	10,544	59	11,603,994	10,576
30	11,297,753		60	11,614,570	

19 Degr.			19 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	11,614,570		30	11,932,339	
		10,577			10,609
1	11,625,147		31	11,942,948	
		10,578			10,610
2	11,635,725		32	11,953,558	
		10,579			10,611
3	11,646,304		33	11,964,169	
		10,580			10,612
4	11,656,884		34	11,974,781	
		10,581			10,613
5	11,667,465		35	11,985,394	
		10,582			10,615
6	11,678,047		36	11,996,009	
		10,583			10,616
7	11,688,630		37	12,006,625	
		10,584			10,617
8	11,699,214		38	12,017,242	
		10,585			10,618
9	11,709,799		39	12,027,860	
		10,586			10,619
10	11,720,385		40	12,038,479	
		10,587			10,620
11	11,730,972		41	12,049,099	
		10,588			10,621
12	11,741,560		42	12,059,720	
		10,590			10,622
13	11,752,150		43	12,070,342	
		10,591			10,623
14	11,762,741		44	12,080,965	
		10,592			10,625
15	11,773,333		45	12,091,590	
		10,593			10,626
16	11,783,926		46	12,102,216	
		10,594			10,627
17	11,794,520		47	12,112,843	
		10,595			10,628
18	11,805,115		48	12,123,471	
		10,596			10,629
19	11,815,711		49	12,134,100	
		10,597			10,630
20	11,826,308		50	12,144,730	
		10,598			10,631
21	11,836,906		51	12,155,361	
		10,599			10,632
22	11,847,505		52	12,165,993	
		10,600			10,633
23	11,858,105		53	12,176,636	
		10,601			10,635
24	11,868,706		54	12,187,261	
		10,603			10,636
25	11,879,309		55	12,197,897	
		10,604			10,637
26	11,889,913		56	12,208,534	
		10,605			10,638
27	11,900,518		57	12,219,172	
		10,606			10,639
28	11,911,124		58	12,229,811	
		10,607			10,640
29	11,921,731		59	12,240,451	
		10,608			10,641
30	11,932,339		60	12,251,292	

20 Degr.			20 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	12,251,292		30	12,571,059	
		10,642			10,677
1	12,261,934		31	12,581,736	
		10,644			10,678
2	12,272,578		32	12,592,414	
		10,645			10,679
3	12,283,223		33	12,603,093	
		10,646			10,680
4	12,293,869		34	12,613,773	
		10,647			10,681
5	12,304,516		35	12,624,454	
		10,648			10,683
6	12,315,164		36	16,635,137	
		10,649			10,684
7	12,325,813		37	12,645,821	
		10,650			10,685
8	12,336,463		38	12,656,506	
		10,651			10,686
9	12,347,114		39	12,667,192	
		10,653			10,687
10	12,357,767		40	12,677,879	
		10,654			10,688
11	12,368,421		41	12,688,567	
		10,655			10,690
12	12,379,076		42	12,699,257	
		10,656			10,691
13	12,389,732		43	12,709,948	
		10,657			10,692
14	12,400,389		44	12,720,640	
		10,658			10,693
15	12,411,047		45	12,731,333	
		10,659			10,694
16	12,421,706		46	12,742,027	
		10,661			10,696
17	12,432,367		47	12,752,723	
		10,662			10,697
18	12,443,029		48	12,763,420	
		10,663			10,698
19	12,453,692		49	12,774,118	
		10,664			10,699
20	12,464,356		50	12,784,817	
		10,665			10,700
21	12,475,021		51	12,795,517	
		10,666			10,701
22	12,485,687		52	12,806,218	
		10,667			10,703
23	12,496,354		53	12,816,921	
		10,669			10,704
24	12,507,023		54	12,827,625	
		10,670			10,705
25	12,517,693		55	12,838,330	
		10,671			10,706
26	12,528,364		56	12,849,036	
		10,672			10,707
27	12,539,036		57	12,859,743	
		10,673			10,709
28	12,549,709		58	12,870,452	
		10,674			10,710
29	12,560,383		59	12,881,162	
		10,676			10,711
30	12,571,059		60	12,891,873	

21 Degr.			21 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	12,891,873		30	13,213,763	
		10,712			10,749
1	12,902,585		31	13,224,512	
		10,713			10,750
2	12,913,298		32	13,235,262	
		10,715			10,751
3	12,924,013		33	13,246,013	
		10,716			10,752
4	12,934,729		34	13,256,765	
		10,717			10,754
5	12,945,446		35	13,267,519	
		10,718			10,755
6	12,956,164		36	13,278,274	
		10,719			10,756
7	12,966,883		37	13,289,030	
		10,721			10,757
8	12,977,604		38	13,299,787	
		10,722			10,758
9	12,988,326		39	13,310,545	
		10,723			10,760
10	12,999,049		40	13,321,305	
		10,724			10,761
11	13,009,773		41	13,332,066	
		10,725			10,762
12	13,020,498		42	13,342,828	
		10,727			10,763
13	13,031,225		43	13,353,591	
		10,728			10,765
14	13,041,953		44	13,364,356	
		10,729			10,766
15	13,052,682		45	13,375,122	
		10,730			10,767
16	13,063,412		46	13,385,889	
		10,731			10,768
17	13,074,143		47	13,396,657	
		10,733			10,770
18	13,084,876		48	13,407,427	
		10,734			10,771
19	13,095,610		49	13,418,198	
		10,735			10,772
20	13,106,345		50	13,428,970	
		10,736			10,773
21	13,117,081		51	13,439,743	
		10,738			10,775
22	13,127,819		52	13,450,518	
		10,739			10,776
23	13,138,558		53	13,461,294	
		10,740			10,777
24	13,149,298		54	13,472,071	
		10,741			10,779
25	13,160,039		55	13,482,850	
		10,742			10,780
26	13,170,781		56	13,493,630	
		10,744			10,781
27	13,181,525		57	13,504,411	
		10,745			10,782
28	13,192,270		58	13,515,193	
		10,746			10,784
29	13,203,016		59	13,525,977	
		10,747			10,785
30	13,213,763		60	13,536,762	

22 Degr.			22 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	13,536,762		30	13,860,902	
		10,786			10,825
1	13,547,548		31	13,871,727	
		10,787			10,826
2	13,558,335		32	13,882,553	
		10,789			10,827
3	13,569,124		33	13,893,380	
		10,790			10,829
4	13,579,914		34	13,904,209	
		10,791			10,830
5	13,590,705		35	13,915,039	
		10,792			10,831
6	13,601,497		36	13,925,870	
		10,794			10,833
7	13,612,291		37	13,936,703	
		10,795			10,834
8	13,623,086		38	13,947,537	
		10,796			10,835
9	13,633,882		39	13,958,372	
		10,798			10,837
10	13,644,680		40	13,969,209	
		10,799			10,838
11	13,655,479		41	13,980,047	
		10,800			10,839
12	13,666,279		42	13,990,886	
		10,801			10,840
13	13,677,070		43	14,001,726	
		10,803			10,842
14	13,687,873		44	14,012,568	
		10,804			10,843
15	13,698,677		45	14,023,411	
		10,805			10,845
16	13,709,492		46	14,034,255	
		10,807			10,846
17	13,720,299		47	14,045,101	
		10,808			10,847
18	13,731,107		48	14,055,948	
		10,809			10,848
19	13,741,916		49	14,066,796	
		10,810			10,850
20	13,752,726		50	14,077,646	
		10,812			10,851
21	13,763,538		51	14,088,497	
		10,813			10,852
22	13,774,351		52	14,099,349	
		10,814			10,854
23	13,785,165		53	14,110,203	
		10,816			10,855
24	13,795,981		54	14,121,058	
		10,817			10,856
25	13,806,798		55	14,131,914	
		10,818			10,858
26	13,817,616		56	14,142,772	
		10,820			10,859
27	13,828,436		57	14,153,631	
		10,821			10,860
28	13,839,257		58	14,164,491	
		10,822			10,862
29	13,850,079		59	14,175,353	
		10,823			10,863
30	13,860,902		60	14,186,216	

23 Degr.			23 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	14,186,216		30	14,512,719	
		10,864			10,905
1	14,197,080		31	14,523,624	
		10,866			10,907
2	14,207,946		32	14,534,531	
		10,867			10,908
3	14,218,813		33	14,545,439	
		10,868			10,909
4	14,229,681		34	14,556,348	
		10,870			10,911
5	14,240,551		35	14,567,259	
		10,871			10,912
6	14,251,422		36	14,578,171	
		10,873			10,914
7	14,262,275		37	14,589,085	
		10,874			10,915
8	14,273,149		38	14,600,000	
		10,875			10,916
9	14,284,024		39	14,610,916	
		10,877			10,918
10	14,294,901		40	14,621,834	
		10,878			10,919
11	14,305,779		41	14,632,753	
		10,879			10,921
12	14,316,658		42	14,643,674	
		10,881			10,922
13	14,327,539		43	14,654,596	
		10,882			10,923
14	14,338,421		44	14,665,519	
		10,883			10,925
15	14,349,304		45	14,676,444	
		10,885			10,926
16	14,360,189		46	14,687,370	
		10,886			10,928
17	14,371,075		47	14,698,298	
		10,887			10,929
18	14,381,962		48	14,709,227	
		10,889			10,930
19	14,392,851		49	14,720,157	
		10,890			10,932
20	14,403,741		50	14,731,089	
		10,892			10,933
21	14,414,633		51	14,742,022	
		10,893			10,935
22	14,425,526		52	14,752,957	
		10,894			10,936
23	14,436,420		53	14,763,893	
		10,896			10,937
24	14,447,316		54	14,774,830	
		10,897			10,939
25	14,458,213		55	14,785,769	
		10,898			10,940
26	14,469,111		56	14,796,709	
		10,900			10,942
27	14,480,011		57	14,807,651	
		10,901			10,943
28	14,490,912		58	14,818,594	
		10,903			10,944
29	14,501,815		59	14,829,538	
		10,904			10,946
30	14,512,719		60	14,840,484	

24 Degr.			24 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	14,840,484		30	15,169,526	
		10,947			10,990
1	14,851,431		31	15,180,516	
		10,949			10,992
2	14,862,380		32	15,191,508	
		10,950			10,993
3	14,873,330		33	15,202,501	
		10,952			10,995
4	14,884,282		34	15,213,496	
		10,953			10,996
5	14,895,235		35	15,224,492	
		10,954			10,998
6	14,906,189		36	15,235,490	
		10,956			10,999
7	14,917,145		37	15,246,489	
		10,957			11,001
8	14,928,102		38	15,257,490	
		10,959			11,002
9	14,939,061		39	15,268,492	
		10,960			11,004
10	14,950,021		40	15,279,496	
		10,962			11,005
11	14,960,983		41	15,290,501	
		10,963			11,007
12	14,971,946		42	15,301,508	
		10,964			11,008
13	14,982,910		43	15,312,516	
		10,966			11,010
14	14,993,876		44	15,323,526	
		10,967			11,011
15	15,004,843		45	15,334,537	
		10,969			11,012
16	15,015,812		46	15,345,549	
		10,970			11,014
17	15,026,782		47	15,356,563	
		10,972			11,015
18	15,037,754		48	15,367,578	
		10,973			11,017
19	15,048,727		49	15,378,595	
		10,974			11,018
20	15,059,701		50	15,389,613	
		10,976			11,020
21	15,070,677		51	15,400,633	
		10,977			11,021
22	15,081,654		52	15,411,654	
		10,979			11,023
23	15,092,633		53	15,422,677	
		10,980			11,024
24	15,103,613		54	15,433,701	
		10,982			11,026
25	15,114,595		55	15,444,727	
		10,983			11,027
26	15,125,578		56	15,455,754	
		10,985			11,029
27	15,136,563		57	15,466,783	
		10,986			11,030
28	15,147,549		58	15,477,813	
		10,988			11,032
29	15,158,537		59	15,488,845	
		10,989			11,033
30	15,169,526		60	15,499,878	

25 Degr.			25 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	15,499,878		30	15,831,578	
		11,035			11,080
1	15,510,913		31	15,842,658	
		11,036			11,082
2	15,521,949		32	15,853,740	
		11,038			11,083
3	15,532,987		33	15,864,823	
		11,039			11,085
4	15,544,026		34	15,875,908	
		11,041			11,086
5	15,555,067		35	15,886,994	
		11,042			11,088
6	15,566,109		36	15,898,082	
		11,044			11,090
7	15,577,153		37	15,909,172	
		11,045			11,091
8	15,588,198		38	15,920,263	
		11,047			11,093
9	15,599,245		39	15,931,356	
		11,048			11,094
10	15,610,293		40	15,942,450	
		11,050			11,096
11	15,621,343		41	15,953,546	
		11,051			11,097
12	15,632,394		42	15,964,643	
		11,053			11,099
13	15,643,447		43	15,975,742	
		11,054			11,100
14	15,654,501		44	15,986,842	
		11,056			11,102
15	15,665,557		45	15,997,944	
		11,057			11,104
16	15,676,614		46	16,009,048	
		11,059			11,105
17	15,687,673		47	16,020,153	
		11,060			11,107
18	15,698,733		48	16,031,260	
		11,062			11,108
19	15,709,805		49	16,042,368	
		11,063			11,110
20	15,720,858		50	16,053,478	
		11,065			11,111
21	15,731,923		51	16,064,589	
		11,067			11,113
22	15,742,990		52	16,075,702	
		11,068			11,115
23	15,754,058		53	16,086,817	
		11,070			11,116
24	15,765,128		54	16,097,933	
		11,071			11,118
25	15,776,199		55	16,109,051	
		11,073			11,119
26	15,787,272		56	16,120,170	
		11,074			11,121
27	15,798,346		57	16,131,291	
		11,076			11,122
28	15,809,432		58	16,142,413	
		11,077			11,124
29	15,820,499		59	16,153,537	
		11,079			11,126
30	15,831,578		60	16,164,663	

26 Degr.			26 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	16,164,663		30	16,499,170	
		11,127			11,175
1	16,175,790		31	16,510,345	
		11,129			11,177
2	16,186,919		32	16,521,522	
		11,130			11,178
3	16,198,049		33	16,532,700	
		11,132			11,180
4	16,209,181		34	16,543,880	
		11,133			11,182
5	16,220,314		35	16,555,062	
		11,135			11,183
6	16,231,449		36	16,566,245	
		11,137			11,185
7	16,242,586		37	16,577,430	
		11,138			11,187
8	16,253,724		38	16,588,617	
		11,140			11,188
9	16,264,864		39	16,599,805	
		11,141			11,190
10	16,276,005		40	16,610,995	
		11,143			11,191
11	16,287,148		41	16,622,186	
		11,145			11,193
12	16,298,293		42	16,633,379	
		11,146			11,195
13	16,309,439		43	16,644,574	
		11,148			11,196
14	16,320,587		44	16,655,770	
		11,149			11,198
15	16,331,736		45	16,666,968	
		11,151			11,200
16	16,342,887		46	16,678,168	
		11,153			11,201
17	16,354,040		47	16,689,369	
		11,154			11,203
18	16,365,194		48	16,700,572	
		11,156			11,205
19	16,376,350		49	16,711,777	
		11,157			11,206
20	16,387,507		50	16,722,983	
		11,159			11,208
21	16,398,666		51	16,734,191	
		11,161			11,210
22	16,409,827		52	16,745,401	
		11,162			11,211
23	16,420,989		53	16,756,612	
		11,164			11,213
24	16,432,153		54	16,767,825	
		11,165			11,214
25	16,443,318		55	16,779,039	
		11,167			11,216
26	16,454,485		56	16,790,255	
		11,169			11,218
27	16,465,654		57	16,801,473	
		11,170			11,219
28	16,476,824		58	16,812,692	
		11,172			11,221
29	16,487,996		59	16,823,913	
		11,174			11,223
30	16,499,170		60	16,835,136	

27 Degr.			27 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	16,835,136		30	17,172,579	
		11,224			11,275
1	16,846,360		31	17,183,854	
		11,226			11,277
2	16,857,586		32	17,195,131	
		11,228			11,278
3	16,868,814		33	17,206,409	
		11,229			11,280
4	16,880,043		34	17,217,689	
		11,231			11,282
5	16,891,274		35	17,228,971	
		11,233			11,284
6	16,902,507		36	17,240,255	
		11,234			11,285
7	16,913,741		37	17,251,540	
		11,236			11,287
8	16,924,977		38	17,262,827	
		11,238			11,289
9	16,936,215		39	17,274,116	
		11,239			11,290
10	16,947,454		40	17,285,406	
		11,241			11,292
11	16,958,695		41	17,296,698	
		11,243			11,294
12	16,969,938		42	17,307,992	
		11,245			11,296
13	16,981,183		43	17,319,288	
		11,246			11,297
14	16,992,429		44	17,330,585	
		11,248			11,299
15	17,003,677		45	17,341,884	
		11,250			11,301
16	17,014,927		46	17,353,185	
		11,251			11,303
17	17,026,178		47	17,364,488	
		11,253			11,304
18	17,037,431		48	17,375,792	
		11,255			11,306
19	17,048,686		49	17,387,098	
		11,256			11,308
20	17,059,942		50	17,398,406	
		11,258			11,309
21	17,071,200		51	17,409,715	
		11,260			11,311
22	17,082,460		52	17,421,026	
		11,261			11,313
23	17,093,721		53	17,432,339	
		11,263			11,315
24	17,104,964		54	17,443,654	
		11,265			11,316
25	17,116,229		55	17,454,970	
		11,267			11,318
26	17,127,496		56	17,466,288	
		11,268			11,320
27	17,138,764		57	17,477,608	
		11,270			11,322
28	17,150,034		58	17,488,930	
		11,272			11,323
29	17,161,305		59	17,500,253	
		11,273			11,325
30	17,172,579		60	17,511,578	

28 Degr.			28 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	17,511,578		30	17,852,155	
		11,327			11,380
1	17,522,905		31	17,863,535	
		11,329			11,382
2	17,534,234		32	17,874,917	
		11,330			11,384
3	17,545,564		33	17,886,301	
		11,332			11,386
4	17,556,896		34	17,897,687	
		11,334			11,387
5	17,568,230		35	17,909,074	
		11,336			11,389
6	17,579,566		36	17,920,463	
		11,337			11,391
7	17,590,903		37	17,931,854	
		11,339			11,393
8	17,602,242		38	17,943,247	
		11,341			11,395
9	17,613,583		39	17,954,642	
		11,343			11,396
10	17,624,926		40	17,966,038	
		11,345			11,398
11	17,636,271		41	17,977,436	
		11,346			11,400
12	17,647,617		42	17,988,836	
		11,348			11,402
13	17,658,965		43	18,000,238	
		11,350			11,404
14	17,670,315		44	18,011,642	
		11,352			11,406
15	17,681,667		45	18,023,048	
		11,353			11,407
16	17,693,020		46	18,034,455	
		11,355			11,409
17	17,704,375		47	18,045,864	
		11,357			11,411
18	17,715,732		48	18,057,275	
		11,359			11,413
19	17,727,091		49	18,068,688	
		11,361			11,415
20	17,738,452		50	18,080,103	
		11,362			11,417
21	17,749,814		51	18,091,520	
		11,364			11,418
22	17,761,178		52	18,102,938	
		11,366			11,420
23	17,772,544		53	18,114,358	
		11,368			11,422
24	17,783,912		54	18,125,780	
		11,369			11,424
25	17,795,281		55	18,137,204	
		11,371			11,426
26	17,806,652		56	18,148,630	
		11,373			11,428
27	17,818,025		57	18,160,058	
		11,375			11,429
28	17,829,400		58	18,171,487	
		11,377			11,431
29	17,840,777		59	18,182,918	
		11,378			11,433
30	17,852,155		60	18,194,351	

29 Degr.			29 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	18,194,351		30	18,538,207	
		11,435			11,491
1	18,205,786		31	18,549,698	
		11,437			11,493
2	18,217,223		32	18,561,191	
		11,439			11,495
3	18,228,662		33	18,572,686	
		11,440			11,497
4	18,240,102		34	18,584,183	
		11,442			11,499
5	18,251,544		35	18,595,682	
		11,444			11,500
6	18,262,988		36	18,607,182	
		11,446			11,502
7	18,274,434		37	18,618,684	
		11,448			11,504
8	18,285,882		38	18,630,188	
		11,450			11,506
9	18,297,332		39	18,641,694	
		11,452			11,508
10	18,308,784		40	18,653,202	
		11,453			11,510
11	18,320,237		41	18,664,712	
		11,455			11,512
12	18,331,692		42	18,676,224	
		11,457			11,514
13	18,343,149		43	18,687,738	
		11,459			11,516
14	18,354,608		44	18,699,254	
		11,461			11,518
15	18,366,069		45	18,710,772	
		11,463			11,520
16	18,377,532		46	18,722,292	
		11,465			11,521
17	18,388,997		47	18,733,813	
		11,466			11,523
18	18,400,463		48	18,745,336	
		11,468			11,525
19	18,411,931		49	18,756,861	
		11,470			11,527
20	18,423,401		50	18,768,388	
		11,472			11,529
21	18,434,873		51	18,779,917	
		11,474			11,531
22	18,446,347		52	18,791,448	
		11,476			11,533
23	18,457,823		53	18,802,981	
		11,478			11,535
24	18,469,301		54	18,814,516	
		11,480			11,537
25	18,480,781		55	18,826,053	
		11,482			11,539
26	18,492,263		56	18,837,592	
		11,483			11,541
27	18,503,746		57	18,849,133	
		11,485			11,543
28	18,515,231		58	18,860,676	
		11,487			11,545
29	18,526,718		59	18,872,221	
		11,489			11,547
30	18,538,207		60	18,883,768	

30 Degr.			30 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	18,883,768		30	19,231,072	
		11,548			11,607
1	18,895,316		31	19,242,679	
		11,550			11,609
2	18,906,866		32	19,254,288	
		11,552			11,611
3	18,918,418		33	19,265,899	
		11,554			11,613
4	18,929,972		34	19,277,512	
		11,556			11,615
5	18,941,528		35	19,289,127	
		11,558			11,617
6	18,953,086		36	19,300,734	
		11,560			11,619
7	18,964,646		37	19,312,353	
		11,562			11,621
8	18,976,208		38	19,323,974	
		11,564			11,623
9	18,987,772		39	19,335,597	
		11,566			11,625
10	18,999,338		40	19,347,222	
		11,568			11,627
11	19,010,906		41	19,358,849	
		11,570			11,629
12	19,022,476		42	19,370,478	
		11,572			11,631
13	19,034,048		43	19,382,109	
		11,574			11,633
14	19,045,622		44	19,393,742	
		11,576			11,635
15	19,057,198		45	19,405,377	
		11,578			11,637
16	19,068,776		46	19,417,014	
		11,580			11,639
17	19,080,356		47	19,428,653	
		11,582			11,641
18	19,091,938		48	19,440,294	
		11,584			11,644
19	19,103,522		49	19,451,938	
		11,586			11,646
20	19,115,108		50	19,463,584	
		11,588			11,648
21	19,126,696		51	19,475,232	
		11,590			11,650
22	19,138,286		52	19,486,882	
		11,592			11,652
23	19,149,878		53	19,498,534	
		11,594			11,654
24	19,161,472		54	19,510,188	
		11,595			11,656
25	19,173,067		55	19,521,844	
		11,597			11,658
26	19,184,664		56	19,533,502	
		11,599			11,660
27	19,196,263		57	19,545,162	
		11,601			11,662
28	19,207,864		58	19,556,824	
		11,603			11,664
29	19,219,467		59	19,568,488	
		11,605			11,666
30	19,231,072		60	19,580,154	

31 Degr.			31 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	19,580,154		30	19,931,085	
		11,668			11,730
1	19,591,822		31	19,942,815	
		11,670			11,732
2	19,603,492		32	19,954,547	
		11,672			11,734
3	19,615,164		33	19,966,281	
		11,674			11,736
4	19,626,838		34	19,978,017	
		11,676			11,738
5	19,638,514		35	19,989,755	
		11,678			11,740
6	19,650,192		36	20,001,495	
		11,680			11,742
7	19,661,872		37	20,013,237	
		11,682			11,745
8	19,673,554		38	20,024,982	
		11,684			11,747
9	19,685,238		39	20,036,729	
		11,686			11,749
10	19,696,924		40	20,048,478	
		11,688			11,751
11	19,708,612		41	20,060,229	
		11,690			11,753
12	19,720,302		42	20,071,982	
		11,692			11,755
13	19,731,994		43	20,083,737	
		11,695			11,757
14	19,743,699		44	20,095,494	
		11,697			11,759
15	19,755,396		45	20,107,253	
		11,699			11,761
16	19,767,085		46	20,119,014	
		11,701			11,764
17	19,778,786		47	20,130,778	
		11,703			11,766
18	19,790,489		48	20,142,544	
		11,705			11,768
19	19,802,194		49	20,154,312	
		11,707			11,770
20	19,813,901		50	20,166,082	
		11,709			11,772
21	19,825,610		51	20,177,854	
		11,711			11,774
22	19,837,321		52	20,189,628	
		11,713			11,776
23	19,849,034		53	20,201,404	
		11,715			11,778
24	19,860,749		54	20,213,182	
		11,717			11,781
25	19,872,466		55	20,224,963	
		11,719			11,783
26	19,884,185		56	20,236,746	
		11,722			11,785
27	19,895,907		57	20,248,531	
		11,724			11,787
28	19,907,631		58	20,260,318	
		11,726			11,789
29	19,919,357		59	20,272,107	
		11,728			11,791
30	19,931,085		60	20,283,898	

32 Degr.			32 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	20,283,898		30	20,638,641	
		11,793			11,859
1	20,295,691		31	20,650,500	
		11,796			11,861
2	20,307,487		32	20,662,361	
		11,798			11,863
3	20,319,285		33	20,674,224	
		11,800			11,865
4	20,331,085		34	20,686,089	
		11,802			11,867
5	20,342,887		35	20,697,956	
		11,804			11,870
6	20,354,691		36	20,709,826	
		11,806			11,872
7	20,366,497		37	20,721,702	
		11,808			11,874
8	20,378,305		38	20,733,576	
		11,811			11,876
9	20,390,116		39	20,745,452	
		11,813			11,878
10	20,401,929		40	20,757,330	
		11,815			11,881
11	20,413,744		41	20,769,211	
		11,817			11,883
12	20,425,561		42	20,781,094	
		11,819			11,885
13	20,437,380		43	20,792,979	
		11,821			11,887
14	20,449,201		44	20,804,866	
		11,824			11,890
15	20,461,025		45	20,816,756	
		11,826			11,892
16	20,472,851		46	20,828,648	
		11,828			11,894
17	20,484,679		47	20,840,542	
		11,830			11,896
18	20,496,509		48	20,852,438	
		11,832			11,898
19	20,508,341		49	20,864,336	
		11,835			11,901
20	20,520,176		50	20,876,237	
		11,837			11,903
21	20,532,013		51	20,888,140	
		11,839			11,905
22	20,543,852		52	20,900,045	
		11,841			11,907
23	20,555,693		53	20,911,952	
		11,843			11,910
24	20,567,536		54	20,923,862	
		11,845			11,912
25	20,579,381		55	20,935,774	
		11,848			11,914
26	20,591,229		56	20,947,688	
		11,850			11,916
27	20,603,079		57	20,959,604	
		11,852			11,919
28	20,614,931		58	20,971,523	
		11,854			11,921
29	20,626,785		59	20,983,444	
		11,856			11,923
30	20,638,641		60	20,995,367	

33 Degr.			33 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	20,995,367		30	21,354,117	
		11,925			11,994
1	21,007,292	11,928	31	21,366,111	11,996
2	21,019,220	11,930	32	21,378,107	11,998
3	21,031,150		33	21,390,105	
		11,932			12,001
4	21,043,082	11,934	34	21,402,106	12,003
5	21,055,016	11,937	35	21,414,109	12,005
6	21,066,953		36	21,426,114	
		11,939			12,008
7	21,078,892	11,941	37	21,438,122	12,010
8	21,090,833	11,943	38	21,450,132	12,012
9	21,102,776		39	21,462,144	
		11,946			12,015
10	21,114,722	11,948	40	21,474,159	12,017
11	21,126,670	11,950	41	21,486,176	12,019
12	21,138,620		42	21,498,195	
		11,953			12,022
13	21,150,573	11,955	43	21,510,217	12,024
14	21,162,528	11,957	44	21,522,241	12,026
15	21,174,485		45	21,534,267	
		11,959			12,029
16	21,186,444	11,962	46	21,546,296	12,031
17	21,198,406	11,964	47	21,558,327	12,033
18	21,210,370		48	21,570,360	
		11,966			12,036
19	21,222,336	11,969	49	21,582,396	12,038
20	21,234,305	11,971	50	21,594,434	12,040
21	21,246,276		51	21,606,474	
		11,973			12,043
22	21,258,249	11,975	52	21,618,517	12,045
23	21,270,224	11,978	53	21,630,562	12,048
24	21,282,202		54	21,642,610	
		11,980			12,050
25	21,294,182	11,982	55	21,654,660	12,052
26	21,306,164	11,985	56	21,666,712	12,055
27	21,318,149		57	21,678,767	
		11,987			12,057
28	21,330,136	11,989	58	21,690,824	12,059
29	21,342,125	11,992	59	21,702,883	12,062
30	21,354,117		60	21,714,945	

34 Degr.			34 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	21,714,945		30	22,077,905	
		12,064			12,136
1	21,727,009		31	22,090,041	
		12,066			12,138
2	21,739,075		32	22,102,179	
		12,069			12,141
3	21,751,144		33	22,114,320	
		12,071			12,143
4	21,763,215		34	22,126,463	
		12,074			12,146
5	21,775,289		35	22,138,609	
		12,076			12,148
6	21,787,365		36	22,150,757	
		12,078			12,150
7	21,799,443		37	22,162,907	
		12,081			12,153
8	21,811,524		38	22,175,060	
		12,083			12,155
9	21,823,607		39	22,187,215	
		12,085			12,158
10	21,835,692		40	22,199,373	
		12,088			12,160
11	21,847,780		41	22,211,533	
		12,090			12,163
12	21,859,870		42	22,223,696	
		12,093			12,165
13	21,871,963		43	22,235,861	
		12,095			12,168
14	21,884,058		44	22,248,029	
		12,097			12,170
15	21,896,155		45	22,260,199	
		12,100			12,173
16	21,908,255		46	22,272,372	
		12,102			12,175
17	21,920,357		47	22,284,547	
		12,105			12,178
18	21,932,462		48	22,296,725	
		12,107			12,180
19	21,944,569		49	22,308,905	
		12,109			12,182
20	21,956,678		50	22,321,087	
		12,112			12,185
21	21,968,790		51	22,333,272	
		12,114			12,187
22	21,980,904		52	22,345,459	
		12,117			12,190
23	21,993,021		53	22,357,649	
		12,119			12,192
24	22,005,140		54	22,369,841	
		12,121			12,195
25	22,017,261		55	22,382,036	
		12,124			12,197
26	22,029,385		56	22,394,233	
		12,126			12,200
27	22,041,511		57	22,406,433	
		12,129			12,202
28	22,053,640		58	22,418,635	
		12,131			12,205
29	22,065,771		59	22,430,840	
		12,134			12,207
30	22,077,905		60	22,443,047	

35 Degr.			35 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	22,443,047		30	22,810,531	
		12,210			12,285
1	22,455,257		31	22,822,816	
		12,212			12,288
2	22,467,469		32	22,835,104	
		12,215			12,290
3	22,479,684		33	22,847,394	
		12,217			12,293
4	22,491,901		34	22,859,687	
		12,220			12,296
5	22,504,221		35	22,871,983	
		12,222			12,298
6	22,516,443		36	22,884,281	
		12,225			12,301
7	22,528,668		37	22,896,582	
		12,227			12,303
8	22,540,895		38	22,908,885	
		12,230			12,306
9	22,553,125		39	22,921,191	
		12,232			12,308
10	22,565,357		40	22,933,499	
		12,235			12,311
11	22,577,592		41	22,945,810	
		12,237			12,314
12	22,589,829		42	22,958,124	
		12,240			12,316
13	22,602,069		43	22,970,440	
		12,242			12,319
14	22,614,311		44	22,982,759	
		12,245			12,321
15	22,626,556		45	22,995,080	
		12,247			12,324
16	22,638,803		46	23,007,404	
		12,250			12,326
17	22,651,053		47	23,019,730	
		12,252			12,329
18	22,663,305		48	23,032,059	
		12,255			12,332
19	22,675,560		49	23,044,391	
		12,257			12,334
20	22,687,817		50	23,056,725	
		12,260			12,337
21	22,700,077		51	23,069,062	
		12,262			12,339
22	22,712,339		52	23,081,401	
		12,265			12,342
23	22,724,604		53	23,093,743	
		12,268			12,345
24	22,736,872		54	23,106,088	
		12,270			12,347
25	22,749,142		55	23,118,435	
		12,273			12,350
26	22,761,415		56	23,130,785	
		12,275			12,352
27	22,773,690		57	23,143,137	
		12,278			12,355
28	22,785,968		58	23,155,492	
		12,280			12,358
29	22,798,248		59	23,167,850	
		12,283			12,360
30	22,810,531		60	23,180,210	

36 Degr.			36 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	23,180,210		30	23,552,344	
		12,363			12,442
1	23,192,573		31	23,564,786	
		12,365			12,445
2	23,204,938		32	23,577,231	
		12,368			12,448
3	23,217,306		33	23,589,679	
		12,371			12,450
4	23,229,677		34	23,602,129	
		12,373			12,453
5	23,242,050		35	23,614,582	
		12,376			12,456
6	23,254,426		36	23,627,038	
		12,379			12,458
7	23,266,805		37	23,639,496	
		12,381			12,461
8	23,279,186		38	23,651,957	
		12,384			12,464
9	23,291,570		39	23,664,421	
		12,386			12,466
10	23,303,956		40	23,676,887	
		12,389			12,469
11	23,316,345		41	23,689,356	
		12,392			12,472
12	23,328,737		42	23,701,828	
		12,394			12,475
13	23,341,133		43	23,714,303	
		12,397			12,477
14	23,353,530		44	23,726,780	
		12,400			12,480
15	23,365,930		45	23,739,260	
		12,402			12,483
16	23,378,332		46	23,751,743	
		12,405			12,485
17	23,390,837		47	23,764,228	
		12,408			12,488
18	23,403,245		48	23,776,716	
		12,410			12,491
19	23,415,655		49	23,789,207	
		12,413			12,494
20	23,428,068		50	23,801,701	
		12,416			12,496
21	23,440,484		51	23,814,197	
		12,418			12,499
22	23,452,902		52	23,826,696	
		12,421			12,502
23	23,465,323		53	23,839,198	
		12,423			12,504
24	23,477,746		54	23,851,702	
		12,426			12,507
25	23,490,172		55	23,864,209	
		12,429			12,510
26	23,502,601		56	23,876,719	
		12,432			12,513
27	23,515,033		57	23,889,232	
		12,434			12,515
28	23,527,467		58	23,901,747	
		12,437			12,518
29	23,539,904		59	23,914,265	
		12,440			12,521
30	23,552,344		60	23,926,786	

37 Degr.			37 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	23,926,786	12,524	30	24,303,699	12,607
1	23,939,310	12,526	31	24,316,306	12,610
2	23,951,836	12,529	32	24,328,916	12,613
3	23,964,365	12,532	33	24,341,529	12,615
4	23,976,897	12,535	34	24,354,144	12,618
5	23,989,432	12,537	35	24,366,762	12,621
6	24,001,969	12,540	36	24,379,383	12,624
7	24,014,509	12,543	37	24,392,007	12,627
8	24,027,052	12,546	38	24,404,634	12,630
9	24,039,598	12,548	39	24,417,264	12,632
10	24,052,146	12,551	40	24,429,896	12,635
11	24,064,697	12,554	41	24,442,531	12,638
12	24,077,251	12,557	42	24,455,169	12,641
13	24,089,808	12,560	43	24,467,810	12,644
14	24,102,368	12,562	44	24,480,454	12,647
15	24,114,930	12,565	45	24,493,101	12,650
16	24,127,495	12,568	46	24,505,751	12,652
17	24,140,063	12,571	47	24,518,403	12,655
18	24,152,634	12,573	48	24,531,058	12,658
19	24,165,207	12,576	49	24,543,716	12,661
20	24,177,783	12,579	50	24,556,377	12,664
21	24,190,362	12,582	51	24,569,041	12,667
22	24,202,944	12,585	52	24,581,708	12,670
23	24,215,529	12,587	53	24,594,378	12,672
24	24,228,116	12,590	54	24,607,050	12,675
25	24,240,706	12,593	55	24,619,725	12,678
26	24,253,299	12,596	56	24,632,403	12,681
27	24,265,895	12,599	57	24,645,084	12,684
28	24,278,494	12,601	58	24,657,768	12,687
29	24,291,095	12,604	59	24,670,455	12,690
30	24,303,699		60	24,683,145	

38 Degr.			38 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	24,683,145		30	25,065,187	
		12,693			12,780
1	24,695,838		31	25,077,967	
		12,695			12,783
2	24,708,533		32	25,090,750	
		12,698			12,786
3	24,721,231		33	25,103,536	
		12,701			12,789
4	24,733,932		34	25,116,325	
		12,704			12,792
5	24,746,636		35	25,129,117	
		12,707			12,795
6	24,759,343		36	25,141,912	
		12,710			12,798
7	24,772,053		37	25,154,710	
		12,713			12,801
8	24,784,766		38	25,167,511	
		12,716			12,804
9	24,797,482		39	25,180,315	
		12,719			12,807
10	24,810,201		40	25,193,122	
		12,722			12,810
11	24,822,923		41	25,205,932	
		12,724			12,813
12	24,835,647		42	25,218,745	
		12,727			12,816
13	24,848,374		43	25,231,561	
		12,730			12,819
14	24,861,104		44	25,244,380	
		12,733			12,822
15	24,873,837		45	25,257,202	
		12,736			12,825
16	24,886,573		46	25,270,027	
		12,739			12,828
17	24,899,312		47	25,282,855	
		12,742			12,831
18	24,912,054		48	25,295,686	
		12,745			12,834
19	24,924,799		49	25,308,520	
		12,748			12,837
20	24,937,547		50	25,321,357	
		12,751			12,840
21	24,950,298		51	25,334,197	
		12,754			12,843
22	24,963,052		52	25,347,040	
		12,757			12,846
23	24,975,809		53	25,359,886	
		12,760			12,849
24	24,988,569		54	25,372,735	
		12,763			12,852
25	25,001,332		55	25,385,587	
		12,765			12,855
26	25,014,097		56	25,398,442	
		12,768			12,858
27	25,026,865		57	25,411,300	
		12,771			12,861
28	25,039,636		58	25,424,161	
		12,774			12,864
29	25,052,410		59	25,437,025	
		12,777			12,867
30	25,065,187		60	25,449,892	

39 Degr.			39 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	25,449,892	12,870	30	25,837,325	12,962
1	25,462,762	12,873	31	25,850,287	12,965
2	25,475,635	12,876	32	25,863,252	12,969
3	25,488,511	12,879	33	25,876,221	12,972
4	25,501,390	12,882	34	25,889,193	12,975
5	25,514,272	12,885	35	25,902,168	12,978
6	25,527,157	12,888	36	25,915,146	12,981
7	25,540,045	12,891	37	25,928,127	12,984
8	25,552,936	12,894	38	25,941,111	12,987
9	25,565,830	12,898	39	25,954,098	12,990
10	25,578,738	12,901	40	25,967,088	12,994
11	25,591,639	12,904	41	25,980,082	12,997
12	25,604,533	12,907	42	25,993,079	13,000
13	25,617,440	12,910	43	26,006,079	13,003
14	25,630,350	12,913	44	26,019,072	13,006
15	25,643,263	12,916	45	26,032,078	13,009
16	25,656,179	12,919	46	26,045,097	13,012
17	25,669,098	12,922	47	26,058,109	13,016
18	25,682,020	12,925	48	26,071,125	13,019
19	25,694,945	12,928	49	26,084,144	13,022
20	25,707,873	12,931	50	26,097,166	13,025
21	25,720,804	12,934	51	26,110,191	13,028
22	25,733,738	12,937	52	26,123,219	13,031
23	25,746,675	12,941	53	26,136,250	13,035
24	25,759,616	12,944	54	26,149,285	13,038
25	25,772,560	12,947	55	26,162,323	13,041
26	25,785,507	12,950	56	26,175,364	13,044
27	25,798,457	12,953	57	26,188,408	13,047
28	25,811,410	12,956	58	26,201,455	13,050
29	25.824,366	12,959	59	26,214,505	13,054
30	25,837,325		60	26,227,559	

40 Degr.			40 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	26,227,559		30	26,620,661	
		13,057			13,154
1	26,240,616		31	26,633,842	
		13,060			13,157
2	26,253,676		32	26,646,999	
		13,063			13,160
3	26,266,739		33	26,660,159	
		13,066			13,163
4	26,279,805		34	26,673,322	
		13,070			13,167
5	26,292,875		35	26,686,489	
		13,073			13,170
6	26,305,948		36	26,699,659	
		13,076			13,173
7	26,319,024		37	26,712,832	
		13,079			13,177
8	26,332,103		38	26,726,009	
		13,082			13,180
9	26,345,185		39	26,739,189	
		13,086			13,183
10	26,358,271		40	26,752,372	
		13,089			13,186
11	26,371,360		41	26,765,558	
		13,092			13,190
12	26,384,452		42	26,778,648	
		13,095			13,193
13	26,397,547		43	26,791,841	
		13,098			13,196
14	26,410,645		44	26,805,037	
		13,102			13,200
15	26,423,747		45	26,818,237	
		13,105			13,203
16	26,436,852		46	26,831,440	
		13,108			13,206
17	26,449,960		47	26,844,646	
		13,111			13,210
18	26,463,071		48	26,857,856	
		13,115			13,213
19	26,476,186		49	26,871,069	
		13,118			13,216
20	26,489,304		50	26,884,285	
		13,121			13,220
21	26,502,425		51	26,897,505	
		13,124			13,223
22	26,515,549		52	26,910,728	
		13,128			13,226
23	26,528,677		53	26,923,954	
		13,131			13,230
24	26,541,808		54	26,937,184	
		13,134			13,233
25	26,554,942		55	26,950,417	
		13,137			13,236
26	26,568,079		56	26,963,653	
		13,141			13,240
27	26,581,220		57	26,976,893	
		13,144			13,243
28	26,594,364		58	26,990,136	
		13,147			13,246
29	26,607,511		59	27,003,382	
		13,150			13,250
30	26,620,661		60	27,016,632	

41 Degr.			41 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	27,016,632		30	27,415,692	
1	27,029,885	13,253	31	27,429,047	13,355
2	27,043,141	13,256	32	27,442,405	13,358
3	27,056,401	13,260	33	27,455,767	13,362
4	27,069,664	13,263	34	27,469,132	13,365
5	27,082,930	13,266	35	27,482,501	13,369
6	27,096,200	13,270	36	27,495,873	13,372
7	27,109,473	13,273	37	27,509,249	13,376
8	27,122,750	13,277	38	27,522,628	13,379
9	27,136,030	13,280	39	27,536,010	13,382
10	27,149,313	13,283	40	27,549,396	13,386
11	27,162,600	13,287	41	27,562,785	13,389
12	27,175,890	13,290	42	27,576,178	13,393
13	27,189,183	13,293	43	27,589,574	13,396
14	27,202,480	13,297	44	27,602,974	13,400
15	27,215,780	13,300	45	27,616,377	13,403
16	27,229,084	13,304	46	27,629,784	13,407
17	27,242,391	13,307	47	27,643,194	13,410
18	27,255,701	13,310	48	27,656,608	13,414
19	27,269,015	13,314	49	27,670,025	13,417
20	27,282,332	13,317	50	27,683,446	13,421
21	27,295,653	13,321	51	27,696,870	13,424
22	27,308,977	13,324	52	27,710,298	13,428
23	27,322,304	13,327	53	27,723,729	13,431
24	27,335,635	13,331	54	27,737,164	13,435
25	27,348,969	13,334	55	27,750,602	13,438
26	27,362,307	13,338	56	27,764,044	13,442
27	27,375,648	13,341	57	27,777,489	13,445
28	27,388,993	13,345	58	27,790,938	13,449
29	27,402,341	13,348	59	27,804,380	13,452
30	27,415,692	13,351	60	27,817,836	13,456

42 Degr.			42 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	27,817,836		30	28,223,163	
		13,459			13,567
1	27,831,295		31	28,236,730	
		13,463			13,570
2	27,844,758		32	28,250,300	
		13,466			13,574
3	27,858,224		33	28,263,874	
		13,470			13,577
4	27,871,694		34	28,277,451	
		13,473			13,581
5	27,885,167		35	28,291,032	
		13,477			13,585
6	27,898,644		36	28,304,617	
		13,481			13,588
7	27,912,125		37	28,318,205	
		13,484			13,592
8	27,925,609		38	28,331,807	
		13,488			13,596
9	27,939,097		39	28,345,403	
		13,491			13,599
10	27,952,588		40	28,358,902	
		13,495			13,603
11	27,966,083		41	28,372,505	
		13,498			13,607
12	27,979,581		42	28,386,112	
		13,502			13,610
13	27,993,083		43	28,399,722	
		13,505			13,614
14	28,006,588		44	28,413,336	
		13,509			13,617
15	28,020,097		45	28,426,953	
		13,513			13,621
16	28,033,610		46	28,440,574	
		13,516			13,625
17	28,047,126		47	28,454,199	
		13,520			13,628
18	28,060,646		48	28,467,827	
		13,523			13,632
19	28,074,169		49	28,481,459	
		13,527			13,636
20	28,087,696		50	28,495,095	
		13,531			13,640
21	28,101,227		51	28,508,735	
		13,534			13,643
22	28,114,761		52	28,522,378	
		13,538			13,647
23	28,128,299		53	28,536,025	
		13,541			13,651
24	28,141,840		54	28,549,676	
		13,545			13,654
25	28,155,385		55	28,563,330	
		13,548			13,658
26	28,168,933		56	28,576,988	
		13,552			13,662
27	28,182,485		57	28,590,650	
		13,556			13,665
28	28,196,041		58	28,604,315	
		13,559			13,669
29	28,209,600		59	28,617,984	
		13,563			13,673
30	28,223,163		60	28,631,657	

43 Degr.			43 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	28,631,657		30	29,043,580	
		13,676			13,789
1	28,645,333		31	29,057,369	
		13,680			13,793
2	28,659,013		32	29,071,162	
		13,684			13,797
3	28,672,697		33	29,084,969	
		13,688			13,801
4	28,686,385		34	29,098,760	
		13,691			13,805
5	28,700,076		35	29,112,565	
		13,695			13,808
6	28,713,771		36	29,126,373	
		13,699			13,812
7	28,727,470		37	29,140,185	
		13,703			13,816
8	28,741,173		38	29,154,001	
		13,706			13,820
9	28,754,879		39	29,167,821	
		13,710			13,824
10	28,768,589		40	29,181,645	
		13,714			13,828
11	28,782,303		41	29,195,473	
		13,718			13,831
12	28,796,021		42	29,209,304	
		13,721			13,835
13	28,809,742		43	29,223,139	
		13,725			13,839
14	28,823,467		44	29,236,978	
		13,729			13,843
15	28,837,196		45	29,250,821	
		13,733			13,847
16	28,850,929		46	29,264,668	
		13,736			13,851
17	28,864,665		47	29,278,519	
		13,740			13,855
18	28,878,405		48	29,292,374	
		13,744			13,858
19	28,892,149		49	29,306,232	
		13,748			13,862
20	28,905,897		50	29,320,094	
		13,751			13,866
21	28,919,648		51	29,333,960	
		13,755			13,870
22	28,933,403		52	29,347,830	
		13,759			13,874
23	28,947,162		53	29,361,704	
		13,763			13,878
24	28,960,925		54	29,375,582	
		13,766			13,882
25	28,974,691		55	29,389,464	
		13,770			13,886
26	28,988,461		56	29,403,350	
		13,774			13,889
27	29,002,235		57	29,417,239	
		13,778			13,893
28	29,016,013		58	29,431,132	
		13,782			13,897
29	29,029,795		59	29,445,029	
		13,785			13,901
30	29,043,580		60	29,458,930	

44 Degr.			44 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	29,458,930		30	29,877,797	
		13,905			14,024
1	29,472,835	13,909	31	29,891,821	14,028
2	29,486,744	13,913	32	29,905,849	14,032
3	29,500,657	13,917	33	29,919,881	14,036
4	29,514,574	13,921	34	29,933,917	14,040
5	29,528,495	13,925	35	29,947,957	14,044
6	29,542,420	13,929	36	29,962,001	14,048
7	29,556,349	13,932	37	29,976,049	14,052
8	29,570,281	13,936	38	29,990,101	14,056
9	29,584,217	13,940	39	30,004,157	14,060
10	29,598,157	13,944	40	20,018,217	14,064
11	29,612,101	13,948	41	30,032,281	14,068
12	29,626,049	13,952	42	30,046,349	14,072
13	29,640,001	13,956	43	30,060,421	14,076
14	29,653,957	13,960	44	30,074,497	14,080
15	29,667,917	13,964	45	30,088,577	14,084
16	29,681,881	13,968	46	30,102,661	14,088
17	29,695,849	13,972	47	30,116,749	14,093
18	29,709,821	13,976	48	30,130,842	14,097
19	29,723,797	13,980	49	30,144,939	14,100
20	29,737,777	13,984	50	30,159,039	14,105
21	29,751,761	13,988	51	30,173,144	14,109
22	29,765,749	13,992	52	30,187,253	14,113
23	29,779,741	13,996	53	30,201,366	14,117
24	29,793,737	14,000	54	30,215,483	14,121
25	29,807,737	14,004	55	30,229,604	14,125
26	29,821,741	14,008	56	30,243,729	14,129
27	29,835,749	14,012	57	30,257,858	14,133
28	29,849,761	14,016	58	30,271,991	14,138
29	29,863,777	14,020	59	30,286,129	14,142
30	29,877,797		60	30,300,271	

45 Degr.			45 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	30,301,271		30	30,726,450	
		14,146			14,271
1	30,314,417		31	30,740,721	
		14,150			14,275
2	30,328,567		32	30,754,996	
		14,154			14,279
3	30,342,721		33	30,769,275	
		14,158			14,284
4	30,356,879		34	30,783,559	
		14,162			14,288
5	30,371,041		35	30,797,847	
		14,166			14,292
6	30,385,207		36	30,812,139	
		14,171			14,296
7	30,399,378		37	30,826,435	
		14,175			14,301
8	30,413,553		38	30,840,736	
		14,179			14,305
9	30,427,732		39	30,855,041	
		14,183			14,309
10	30,441,915		40	30,869,350	
		14,187			14,313
11	30,456,102		41	30,883,663	
		14,191			14,318
12	30,470,293		42	30,897,981	
		14,195			14,322
13	30,484,488		43	30,912,303	
		14,200			14,326
14	30,498,688		44	30,926,629	
		14,204			14,330
15	30,512,892		45	30,940,959	
		14,208			14,335
16	30,527,100		46	30,955,294	
		14,212			14,339
17	30,541,312		47	30,969,633	
		14,216			14,343
18	30,555,528		48	30,983,976	
		14,220			14,348
19	30,569,748		49	30,998,324	
		14,225			14,352
20	30,583,973		50	31,012,676	
		14,229			14,356
21	30,598,202		51	31,027,032	
		14,233			14,360
22	30,612,435		52	31,041,392	
		14,237			14,365
23	30,626,672		53	31,055,757	
		14,241			14,369
24	30,640,913		54	31,070,126	
		14,246			14,373
25	30,655,159		55	31,084,499	
		14,250			14,378
26	30,669,409		56	31,098,877	
		14,254			14,382
27	30,683,663		57	31,113,259	
		14,258			14,386
28	30,697,921		58	31,127,635	
		14,262			14,391
29	30,712,183		59	31,142,026	
		14,267			14,395
30	30,726,450		60	31,156,423	

46 Degr.			46 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	31,156,423		30	31,590,310	
		14,399			14,531
1	31,170,822		31	31,604,841	
		14,404			14,536
2	31,185,226		32	31,619,377	
		14,408			14,540
3	31,199,634		33	31,633,917	
		14,412			14,545
4	31,214,046		34	31,648,462	
		14,417			14,549
5	31,228,463		35	31,663,011	
		14,421			14,554
6	31,242,884		36	31,677,545	
		14,426			14,558
7	31,257,310		37	31,692,103	
		14,430			14,563
8	31,271,740		38	31,706,666	
		14,434			14,567
9	31,286,174		39	31,721,133	
		14,439			14,572
10	31,300,613		40	31,735,705	
		14,443			14,576
11	31,315,056		41	31,750,281	
		14,447			14,581
12	31,329,503		42	31,764,862	
		14,452			14,585
13	31,343,955		43	31,779,447	
		14,456			14,590
14	31,358,411		44	31,794,037	
		14,461			14,594
15	31,372,872		45	31,808,631	
		14,465			14,599
16	31,387,337		46	31,823,230	
		14,469			14,603
17	31,401,806		47	31,837,833	
		14,474			14,608
18	31,416,280		48	31,852,441	
		14,478			14,612
19	31,430,758		49	31,867,053	
		14,483			14,617
20	31,445,241		50	31,881,670	
		14,487			14,621
21	31,459,728		51	31,896,291	
		14,491			14,626
22	31,474,219		52	31,910,917	
		14,496			14,630
23	31,488,715		53	31,925,547	
		14,500			14,635
24	31,503,215		54	31,940,182	
		14,505			14,639
25	31,517,720		55	31,954,821	
		14,509			14,644
26	31,532,229		56	31,969,465	
		14,514			14,649
27	31,546,743		57	31,984,114	
		14,518			14,653
28	31,561,261		58	31,998,767	
		14,522			14,658
29	31,575,783		59	32,013,425	
		14,527			14,662
30	31,590,310		60	32,028,087	

47 Degr.			47 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	32,028,087		30	32,470,102	
		14,667			14,806
1	32,042,754	14,671	31	32,484,908	14,811
2	32,057,425	14,676	32	32,499,719	14,815
3	32,072,101		33	32,514,534	
		14,681			14,820
4	32,086,782	14,685	34	32,529,354	14,825
5	32,101,467	14,690	35	32,544,179	14,830
6	32,116,157		36	32,559,009	
		14,694			14,834
7	32,130,851	14,699	37	32,573,843	14,839
8	32,145,550	14,704	38	32,588,682	14,844
9	32,160,254		39	32,603,526	
		14,708			14,849
10	32,174,962	14,713	40	32,618,375	14,853
11	32,189,675	14,717	41	32,633,228	14,858
12	32,204,392		42	32,648,086	
		14,722			14,863
13	32,219,114	14,727	43	32,662,949	14,868
14	32,233,841	14,731	44	32,677,817	14,872
15	32,248,572		45	32,692,689	
		14,736			14,877
16	32,263,308	14,741	46	32,707,566	14,882
17	32,278,049	14,745	47	32,722,448	14,887
18	32,292,794		48	32,737,335	
		14,750			14,891
19	32,307,544	14,755	49	32,752,226	14,896
20	32,322,299	14,759	50	32,767,122	14,901
21	32,337,058		51	32,782,023	
		14,764			14,906
22	32,351,822	14,769	52	32,796,929	14,911
23	32,366,591	14,773	53	32,811,840	14,915
24	32,381,364		54	32,826,755	
		14,778			14,920
25	32,396,142	14,783	55	32,841,675	14,925
26	32,410,925	14,787	56	32,856,595	14,930
27	32,425,712		57	32,871,525	
		14,792			14,935
28	32,440,504	14,797	58	32,886,460	14,939
29	32,455,301	14,801	59	32,901,399	14,944
30	32,470,102		60	32,916,343	

48 Degr.			48 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	32,916,343		30	33,366,956	
		14,949			15,096
1	32,931,292		31	33,382,052	
		14,954			15,101
2	32,946,246		32	33,397,153	
		14,959			15,106
3	32,961,205		33	33,412,259	
		14,964			15,111
4	32,976,169		34	33,427,370	
		14,968			15,116
5	32,991,137		35	33,442,486	
		14,973			15,121
6	33,006,110		36	33,457,607	
		14,978			15,126
7	33,021,088		37	33,472,733	
		14,983			15,131
8	33,036,071		38	33,487,864	
		14,988			15,136
9	33,051,059		39	33,503,000	
		14,993			15,141
10	33,066,052		40	33,518,141	
		14,998			15,146
11	33,081,050		41	33,533,287	
		15,003			15,151
12	33,096,053		42	33,548,438	
		15,007			15,156
13	33,111,060		43	33,563,594	
		15,012			15,161
14	33,126,072		44	33,578,755	
		15,017			15,166
15	33,141,089		45	33,593,921	
		15,022			15,171
16	33,156,111		46	33,609,092	
		15,027			15,176
17	33,171,138		47	33,624,268	
		15,032			15,181
18	33,186,170		48	33,639,449	
		15,037			15,186
19	33,201,227		49	33,654,635	
		15,042			15,191
20	33,216,269		50	33,669,826	
		15,047			15,196
21	33,231,316		51	33,685,022	
		15,052			15,201
22	33,246,368		52	33,700,223	
		15,056			15,206
23	33,261,424		53	33,715,429	
		15,061			15,212
24	33,276,485		54	33,730,641	
		15,066			15,217
25	33,291,551		55	33,745,858	
		15,071			15,222
26	33,306,622		56	33,761,080	
		15,076			15,227
27	33,321,698		57	33,776,307	
		15,081			15,232
28	33,336,779		58	33,791,539	
		15,086			15,237
29	33,351,865		59	33,806,776	
		15,091			15,242
30	33,366,956		60	33,822,018	

49 Degr.			49 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	33,822,018		30	34,281,672	
		15,247			15,402
1	33,837,265		31	34,297,074	
		15,252			15,408
2	33,852,517		32	34,312,482	
		15,257			15,413
3	33,867,774		33	34,327,895	
		15,262			15,418
4	33,883,036		34	34,343,313	
		15,268			15,423
5	33,898,304		35	34,358,733	
		15,273			15,429
6	33,913,577		36	34,374,162	
		15,278			15,434
7	33,928,855		37	34,389,596	
		15,283			15,439
8	33,944,138		38	34,405,035	
		15,288			15,445
9	33,959,426		39	34,420,480	
		15,293			15,450
10	33,974,719		40	34,435,930	
		15,298			15,455
11	33,990,017		41	34,451,385	
		15,304			15,460
12	34,005,321		42	34,466,845	
		15,309			15,466
13	34,020,630		43	34,482,311	
		15,314			15,471
14	34,035,944		44	34,497,782	
		15,319			15,476
15	34,051,263		45	34,513,258	
		15,324			15,482
16	34,066,587		46	34,528,740	
		15,329			15,487
17	34,081,916		47	34,544,227	
		15,335			15,492
18	34,097,251		48	34,559,719	
		15,340			15,498
19	34,112,591		49	34,575,217	
		15,345			15,503
20	34,127,936		50	34,590,720	
		15,350			15,508
21	34,143,286		51	34,606,228	
		15,355			15,514
22	34,158,641		52	34,621,742	
		15,361			15,519
23	34,173,102		53	34,637,261	
		15,366			15,524
24	34,189,368		54	34,652,785	
		15,371			15,530
25	34,204,739		55	34,668,315	
		15,376			15,535
26	34,220,115		56	34,683,850	
		15,381			15,541
27	34,235,496		57	34,699,391	
		15,387			15,546
28	34,250,883		58	34,714,937	
		15,392			15,551
29	34,266,275		59	34,730,488	
		15,397			15,557
30	34,281,672		60	34,746,045	

50 Degr.			50 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	34,746,045		30	35,215,280	
		15,562			15,726
1	34,761,607		31	35,231,006	
		15,568			15,732
2	34,777,175		32	35,246,738	
		15,573			15,738
3	34,792,748		33	35,262,476	
		15,578			15,743
4	34,808,326		34	35,278,219	
		15,584			15,749
5	34,823,910		35	35,293,968	
		15,589			15,754
6	34,839,499		36	35,309,722	
		15,595			15,760
7	34,855,094		37	35,325,482	
		15,600			15,765
8	34,870,694		38	35,341,247	
		15,605			15,771
9	34,886,299		39	35,357,028	
		15,611			15,777
10	34,901,910		40	35,372,805	
		15,616			15,782
11	34,917,526		41	35,388,587	
		15,622			15,788
12	34,933,148		42	35,404,375	
		15,627			15,793
13	34,948,775		43	35,420,168	
		15,633			15,799
14	34,964,408		44	35,435,967	
		15,638			15,805
15	34,980,046		45	35,451,772	
		15,644			15,810
16	34,995,690		46	35,467,582	
		15,649			15,816
17	35,011,339		47	35,483,398	
		15,655			15,822
18	35,026,994		48	35,499,220	
		15,660			15,827
19	35,042,654		49	35,515,047	
		15,666			15,833
20	35,058,320		50	35,530,880	
		15,671			15,839
21	35,073,991		51	35,546,719	
		15,677			15,844
22	35,089,668		52	35,562,563	
		15,682			15,850
23	35,105,350		53	35,578,413	
		15,688			15,856
24	35,121,038		54	35,594,269	
		15,693			15,861
25	35,136,731		55	35,610,130	
		15,699			15,867
26	35,152,430		56	35,625,997	
		15,704			15,873
27	35,168,134		57	35,641,870	
		15,710			15,878
28	35,183,844		58	35,657,748	
		15,715			15,884
29	35,199,559		59	35,673,632	
		15,721			15,890
30	35,215,280		60	35,689,522	

51 Degr.			51 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	35,689,522		30	36,168,893	
		15,895			16,069
1	35,705,417	15,901	31	36,184,962	16,075
2	35,721,318	15,907	32	36,201,037	16,081
3	35,737,225	15,913	33	36,217,118	16,087
4	35,753,138	15,918	34	36,233,205	16,093
5	35,769,056	15,924	35	36,249,298	16,099
6	35,784,980	15,930	36	36,265,397	16,105
7	35,800,910	15,936	37	36,281,502	16,111
8	35,816,846	15,941	38	36,297,613	16,116
9	35,832,787	15,947	39	36,313,729	16,122
10	35,848,734	15,953	40	36,329,851	16,128
11	35,864,687	15,959	41	36,345,979	16,134
12	35,880,646	15,964	42	36,362,113	16,140
13	35,896,610	15,970	43	36,378,253	16,146
14	35,912,580	15,976	44	36,394,399	16,152
15	35,928,556	15,982	45	36,410,551	16,158
16	35,944,538	15,987	46	36,426,709	16,164
17	35,960,525	15,993	47	36,442,873	16,170
18	35,976,518	15,999	48	36,459,043	16,176
19	35,992,517	16,005	49	36,475,219	16,182
20	36,008,522	16,011	50	36,491,401	16,188
21	36,024,533	16,017	51	36,507,589	16,194
22	36,040,550	16,022	52	36,523,783	16,200
23	36,056,572	16,028	53	36,539,983	16,206
24	36,072,600	16,034	54	36,556,189	16,212
25	36,088,634	16,040	55	36,572,401	16,218
26	36,104,674	16,046	56	36,588,619	16,224
27	36,120,720	16,052	57	36,604,843	16,230
28	36,136,772	16,058	58	36,621,073	16,236
29	36,152,830	16,063	59	36,637,309	16,242
30	36,168,893		60	36,653,551	

52 Degr.			52 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	36,653,551	16,248	30	37,143,656	16,433
1	36,669,799	16,254	31	37,160,089	16,439
2	36,686,053	16,260	32	37,176,528	16,445
3	36,702,313	16,266	33	37,192,973	16,451
4	36,718,579	16,273	34	37,209,424	16,458
5	36,734,852	16,279	35	37,225,882	16,464
6	36,751,131	16,285	36	37,242,346	16,470
7	36,767,416	16,291	37	37,258,816	16,476
8	36,783,707	16,297	38	37,275,292	16,483
9	36,800,004	16,303	39	37,291,775	16,489
10	36,816,307	16,309	40	37,308,264	16,495
11	36,832,616	16,315	41	37,324,759	16,501
12	36,848,931	16,321	42	37,341,260	16,508
13	36,865,252	16,327	43	37,357,768	16,514
14	36,881,579	16,334	44	37,374,282	16,520
15	36,897,913	16,340	45	37,390,802	16,527
16	36,914,253	16,346	46	37,407,329	16,533
17	36,930,599	16,352	47	37,423,862	16,539
18	36,946,951	16,358	48	37,440,401	16,546
19	36,963,309	16,364	49	37,456,947	16,552
20	36,979,673	16,370	50	37,473,499	16,558
21	36,996,043	16,377	51	37,490,057	16,565
22	37,012,420	16,383	52	37,506,622	16,571
23	37,028,803	16,389	53	37,523,193	16,578
24	37,045,192	16,395	54	37,539,771	16,584
25	37,061,587	16,401	55	37,556,355	16,590
26	37,077,988	16,408	56	37,572,945	16,597
27	37,094,396	16,414	57	37,589,542	16,603
28	37,110,810	16,420	58	37,606,145	16,609
29	37,127,230	16,426	59	37,622,754	16,616
30	37,143,656		60	37,639,370	

53 Degr.			53 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	37,639,370	16,622	30	38,140,859	16,818
1	37,655,992	16,629	31	38,157,677	16,824
2	37,672,621	16,635	32	38,174,501	16,831
3	37,689,256	16,642	33	38,191,332	16,838
4	37,705,898	16,648	34	38,208,170	16,844
5	37,722,546	16,655	35	38,225,014	16,851
6	37,739,201	16,661	36	38,241,865	16,858
7	37,755,862	16,667	37	38,258,723	16,864
8	37,772,529	16,674	38	38,275,587	16,871
9	37,789,203	16,680	39	38,292,458	16,878
10	37,805,883	16,687	40	38,309,336	16,884
11	37,822,570	16,693	41	38,326,220	16,891
12	37,839,263	16,700	42	38,343,111	16,898
13	37,855,963	16,706	43	38,360,009	16,904
14	37,872,669	16,713	44	38,376,913	16,911
15	37,889,382	16,719	45	38,393,824	16,918
16	37,906,101	16,726	46	38,410,742	16,925
17	37,922,827	16,732	47	38,427,667	16,931
18	37,939,559	16,739	48	38,444,598	16,948
19	37,956,298	16,745	49	38,461,546	16,945
20	37,973,043	16,752	50	38,478 491	16,501
21	37,989,795	16,759	51	38,495,442	16,958
22	38,006,554	16,765	52	38,512,400	16,965
23	38,023,319	16,772	53	38,529,365	16,972
24	38,040,091	16,778	54	38,546,337	16,979
25	38,056,869	16,785	55	38,563,316	16,985
26	38,073,654	16,791	56	38,580,301	16,992
27	38,090,445	16,798	57	38,597,293	16,999
28	38,107,243	16,805	58	38,614,292	17,006
29	38,124,048	16,811	59	38,631,298	17,013
30	38,140,859		60	38,648,311	

54 Degr.			54 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	38,648,311		30	39,161,888	
		17,019			17,227
1	38,665,330		31	39,179,115	
		17,026			17,234
2	38,682,356		32	39,196,349	
		17,033			17,241
3	38,699,389		33	39,213,590	
		17,040			17,248
4	38,716,429		34	39,230,838	
		17,047			17,255
5	38,733,476		35	39,248,093	
		17,054			17,262
6	38,750,530		36	39,265,356	
		17,060			17,269
7	38,767,590		37	39,282,625	
		17,067			17,276
8	38,784,657		38	39,299,901	
		17,074			17,284
9	38,801,731		39	39,317,185	
		17,081			17,291
10	38,818,812		40	39,334,476	
		17,088			17,298
11	38,835,900		41	39,351,774	
		17,095			17,305
12	38,852,995		42	39,369,179	
		17,102			17,302
13	38,870,097		43	39,386,481	
		17,109			17,319
14	38,887,206		44	39,403,800	
		17,115			17,326
15	38,904,321		45	39,421,126	
		17,122			17,333
16	38,921,443		46	39,438,459	
		17,129			17,340
17	38,938,572		47	39,455,799	
		17,136			17,348
18	38,955,708		48	39,473,147	
		17,143			17,355
19	38,972,851		49	39,490,502	
		17,150			17,362
20	38,990,001		50	39,507,864	
		17,157			17,369
21	39,007,158		51	39,525,233	
		17,164			17,376
22	39,024,324		52	39,542,609	
		17,171			17,383
23	39,041,495		53	39,559,992	
		17,178			17,391
24	39,058,673		54	39,577,383	
		17,185			17,398
25	39,075,858		55	39,594,781	
		17,192			17,405
26	39,093,050		56	39,612,186	
		17,199			17,412
27	39,110,249		57	39,629,598	
		17,206			17,420
28	39,127,455		58	39,647,018	
		17,213			17,427
29	39,144,668		59	39,664,445	
		17,220			17,434
30	39,161,888		60	39,681,879	

55 Degr.			55 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	39,681,879		30	40,208,291	
		17,441			17,662
1	39,699,320		31	40,225,953	
		17,448			17,670
2	39,716,768		32	40,243,623	
		17,456			17,677
3	39,734,224		33	40,261,300	
		17,463			17,685
4	39,751,687		34	40,278,985	
		17,470			17,692
5	39,769,157		35	40,296,677	
		17,478			17,700
6	39,786,635		36	40,314,377	
		17,485			17,707
7	39,804,120		37	40,332,084	
		17,492			17,715
8	39,821,612		38	40,349,799	
		17,499			17,722
9	39,839,111		39	40,367,521	
		17,507			17,730
10	39,856,618		40	40,385,251	
		17,514			17,737
11	39,874,122		41	40,402,988	
		17,521			17,745
12	39,891,643		42	40,420,733	
		17,529			17,752
13	39,909,172		43	40,438,485	
		17,536			17,760
14	39,926,708		44	40,456,245	
		17,543			17,768
15	39,944,251		45	40,474,013	
		17,551			17,775
16	39,961,802		46	40,491,788	
		17,558			17,783
17	39,979,360		47	40,509,571	
		17,566			17,790
18	39,996,926		48	40,527,361	
		17,573			17,798
19	40,014,499		49	40,545,159	
		17,580			17,806
20	40,032,079		50	40,562,965	
		17,588			17,813
21	40,049,667		51	40,580,778	
		17,595			17,821
22	40,067,262		52	40,598,599	
		17,603			17,829
23	40,084,865		53	40,616,428	
		17,610			17,836
24	40,102,465		54	40,634,264	
		17,617			17,844
25	40,120,092		55	40,652,108	
		17,625			17,852
26	40,137,717		56	40,669,960	
		17,632			17,859
27	40,155,349		57	40,687,819	
		17,640			17,867
28	40,172,989		58	40,705,686	
		17,647			17,875
29	40,190,636		59	40,723,561	
		17,655			17,882
30	40,208,291		60	40,741,443	

56 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	40,741,443	
		17,890
1	40,759,333	
		17,898
2	40,777,231	
		17,906
3	40,795,137	
		17,913
4	40,813,050	
		17,921
5	40,830,971	
		17,929
6	40,848,900	
		17,937
7	40,866,837	
		17,944
8	40,884,781	
		17,952
9	40,902,733	
		17,960
10	40,920,693	
		17,968
11	40,938,661	
		17,976
12	40,956,637	
		17,983
13	40,974,621	
		17,991
14	70,992,612	
		17,999
15	41,010,611	
		18,007
16	41,028,618	
		18,015
17	41,046,633	
		18,023
18	41,064,656	
		18,030
19	41,082,686	
		18,038
20	41,100,724	
		18,046
21	41,118,770	
		18,054
22	41,136,824	
		18,062
23	41,154,886	
		18,070
24	41,172,956	
		18,078
25	41,191,034	
		18,086
26	41,209,120	
		18,094
27	41,227,214	
		18,102
28	41,245,316	
		18,110
29	41,263,426	
		18,118
30	41,281,544	

56 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	41,281,544	
		18,125
31	41,299,669	
		18,133
32	41,317,802	
		18,141
33	41,335,943	
		18,149
34	41,354,092	
		18,157
35	41,372,249	
		18,165
36	41,390,414	
		18,173
37	41,408,587	
		18,181
38	41,426,768	
		18,190
39	41,444,958	
		18,198
40	41,463,156	
		18,206
41	41,481,362	
		18,214
42	41,499,576	
		18,222
43	41,517,798	
		18,230
44	41,536,028	
		18,238
45	41,554,266	
		18,246
46	41,572,512	
		18,254
47	41,590,766	
		18,262
48	41,609,028	
		18,270
49	41,627,298	
		18,278
50	41,645,576	
		18,287
51	41,663,863	
		18,295
52	41,682,158	
		18,303
53	41,700,461	
		18,311
54	41,718,772	
		18,319
55	41,737,091	
		18,327
56	41,755,418	
		18,336
57	41,773,754	
		18,344
58	41,792,098	
		18,352
59	41,810,450	
		18,360
60	41,828,810	

57 Degr.			57 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	41,828,810		30	42,383,579	
		18,369			18,620
1	41,847,179	18,377	31	42,402,199	18,628
2	41,865,556	18,385	32	42,420,827	18,637
3	41,883,941		33	42,439,464	
		18,393			18,645
4	41,902,334	18,402	34	42,458,109	18,654
5	41,920,736	18,410	35	42,476,763	18,662
6	41,939,146		36	42,495,425	
		18,418			18,671
7	41,957,564	18,426	37	42,514,096	18,679
8	41,975,990	18,435	38	42,532,775	18,688
9	41,994,425		39	42,551,463	
		18,443			18,697
10	42,012,868	18,451	40	42,570,160	18,705
11	42,031,319	18,460	41	42,588,865	18,714
12	42,049,779		42	42,607,579	
		18,468			18,722
13	42,068,247	18,476	43	42,626,301	18,731
14	42,086,723	18,485	44	42,645,032	18,740
15	42,105,208		45	42,663,772	
		18,493			18,748
16	42,123,701	18,501	46	42,682,520	18,757
17	42,142,202	18,510	47	42,701,277	18,766
18	42,160,712		48	42,720,043	
		18,518			18,774
19	42,179,230	18,527	49	42,738,817	18,783
20	42,197,757	18,535	50	42,757,600	18,792
21	42,216,392		51	42,776,392	
		18,543			18,800
22	42,234,935	18,552	52	42,795,192	18,809
23	42,253,487	18,560	53	42,814,001	18,818
24	42,272,047		54	42,832,819	
		18,569			18,826
25	42,290,608	18,577	55	42,851,645	18,835
26	42,309,185	18,586	56	42,870,480	18,844
27	42,327,771		57	42,889,324	
		18,594			18,853
28	42,346,365	18,603	58	42,908,177	18,862
29	42,364,968	18,611	59	42,927,039	18,870
30	42,383,579		60	42,945,909	

58 Degr.			58 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	42,945,909		30	43,516,147	
		18,879			19,147
1	42,964,788		31	43,535,294	
		18,888			19,156
2	42,983,676		32	43,554,450	
		18,897			19,166
3	43,002,573		33	43,573,616	
		18,906			19,175
4	43,021,479		34	43,592,791	
		18,914			19,184
5	43,040,393		35	43,611,975	
		18,923			19,193
6	43,059,316		36	43,631,168	
		18,932			19,202
7	43,078,248		37	43,650,370	
		18,941			19,211
8	43,097,189		38	43,669,581	
		18,950			19,220
9	43,116,139		39	43,688,801	
		18,959			19,230
10	43,135,098		40	43,708,031	
		18,968			19,239
11	43,154,066		41	43,727,270	
		18,976			19,248
12	43,173,042		42	43,746,518	
		18,985			19,257
13	43,192,027		43	43,765,775	
		18,994			19,267
14	43,211,021		44	43,785,042	
		19,003			19,276
15	43,230,024		45	43,804,318	
		19,012			19,285
16	43,249,036		46	43,823,603	
		19,021			19,294
17	43,268,057		47	43,842,897	
		19,030			19,304
18	43,287,087		48	43,862,201	
		19,039			19,313
19	43,306,126		49	43,881,514	
		19,048			19,322
20	43,325,174		50	43,900,836	
		19,057			19,331
21	43,344,231		51	43,920,167	
		19,066			19,341
22	43,363,297		52	43,939,508	
		19,075			19,350
23	43,382,372		53	43,958,858	
		19,084			19,359
24	43,401,458		54	43,978,217	
		19,093			19,369
25	43,420,551		55	43,997,586	
		19,102			19,378
26	43,439,653		56	44,016,964	
		19,111			19,387
27	43,458,764		57	44,036,351	
		19,120			19,397
28	43,477,880		58	44,055,748	
		19,129			19,406
29	43,497,009		59	44,075,154	
		19,138			19,416
30	43,516,147		60	44,094,570	

59 Degr.			59 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	44,094,570		30	44,681,459	
		19,425			19,712
1	44,113,995	19,434	31	44,701,171	19,722
2	44,133,429	19,444	32	44,720,893	19,732
3	44,152,873		33	44,740,625	
		19,453			19,741
4	44,172,326	19,463	34	44,760,366	19,751
5	44,191,789	19,472	35	44,780,117	19,761
6	44,211,261		36	44,799,877	
		19,482			19,771
7	44,230,743	19,491	37	44,819,648	19,781
8	44,250,234	19,501	38	44,839,429	19,790
9	44,269,735		39	44,859,219	
		19,510			19,800
10	44,289,245	19,520	40	44,879,019	19,810
11	44,308,765	19,529	41	44,898,829	19,820
12	44,328,294		42	44,918,649	
		19,539			19,830
13	44,347,833	19,548	43	44,938,479	19,840
14	44,367,381	19,558	44	44,958,319	19,850
15	44,386,939		45	44,978,169	
		19,567			19,860
16	44,406,506	19,577	46	44,998,029	19,869
17	44,426,083	19,586	47	45,017,898	19,879
18	44,445,669		48	45,037,777	
		19,596			19,889
19	44,465,265	19,606	49	45,057,666	19,899
20	44,484,871	19,615	50	45,077,565	19,909
21	44,504,486		51	45,097,474	
		19,625			19,919
22	44,524,111	19,635	52	45,117,393	19,929
23	44,543,746	19,644	53	45,137,322	19,939
24	44,563,390		54	45,157,261	
		19,654			19,949
25	44,583,044	19,664	55	45,177,219	19,959
26	44,602,708	19,673	56	45,197,169	19,969
27	44,622,381		57	45,217,138	
		19,683			19,979
28	44,642,064	19,693	58	45,237,117	19,989
29	44,661,757	19,702	59	45,257,106	20,000
30	44,681,459		60	45,277,106	

60 Degr.			60 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	45,277,106		30	45,881,827	
		20,010			20,318
1	45,297,116	20,020	31	45,902,145	20,328
2	45,317,136	20,030	32	45,922,473	20,339
3	45,337,166		33	45,942,812	
		20,040			20,349
4	45,357,206	20,050	34	45,963,161	20,360
5	45,377,256	20,060	35	45,983,521	20,370
6	45,397,316		36	46,003,891	
		20,070			20,381
7	45,417,386	20,080	37	46,024,272	20,391
8	45,437,466	20,091	38	46,044,663	20,402
9	45,457,557		39	46,065,065	
		20,101			20,412
10	45,477,658	20,111	40	46,085,477	20,423
11	45,497,769	20,121	41	46,105,900	20,433
12	45,517,890		42	46,126,333	
		20,132			20,444
13	45,538,022	20,142	43	46,146,777	20,455
14	45,558,164	20,152	44	46,167,232	20,465
15	45,578,316		45	46,187,697	
		20,162			20,476
16	45,598,478	20,173	46	46,208,173	20,487
17	45 618,651	20,183	47	46,228,660	20,497
18	45,638,834		48	46,249,157	
		20,193			20,508
19	45,659,027	20,203	49	46,269,665	20,519
20	45,679,230	20,214	50	46,290,184	20,529
21	45,699,444		51	46,310,713	
		20,224			20,540
22	45,719,668	20,234	52	46,331,253	20,551
23	45,739,902	20,245	53	46,351,814	20,561
24	45,760,147		54	46,372,365	
		20,255			20,572
25	45,780,402	20,266	55	46,392,937	20,583
26	45,800,668	20,276	56	46,413,520	20,594
27	45,820,944		57	46,434,114	
		20,286			20,605
28	45,841,230	20,297	58	46,454,719	20,615
29	45,861,527	20,307	59	46,475,334	20,626
30	45,881,827		60	46,495,960	

61 Degr.			61 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	46,495,960		30	47,119,836	
		20,637			20,968
1	46,516,597	20,648	31	47,140,804	20,979
2	46,537,245	20,659	32	47,161,783	20,991
3	46,557,904		33	47,182,774	
		20,670			21,002
4	46,578,574	20,680	34	47,203,776	21,013
5	46,599,250	20,691	35	47,224,789	21,025
6	46,619,941		36	47,245,814	
		20,702			21,036
7	46,640,643	20,713	37	47,266,850	21,047
8	46,661,356	20,724	38	47,287,897	21,058
9	46,682,080		39	47,308,955	
		20,735			21,070
10	46,702,815	20,746	40	47,330,025	21,081
11	46,723,561	20,757	41	47,351,106	21,093
12	46,744,318		42	47,372,199	
		20,768			21,104
13	46,765,086	20,779	43	47,393,383	21,115
14	46,785,865	20,790	44	47,414,418	21,127
15	46,806,655		45	47,435,545	
		20,801			21,138
16	46,827,456	20,812	46	47,456,683	21,150
17	46,848,268	20,823	47	47,477,833	21,161
18	46,869,091		48	47,498,984	
		20,834			21,173
19	46,889,925	20,845	49	47,520,167	21,184
20	46,910,770	20,856	50	47,541,351	21,196
21	46,931,626		51	47,562,547	
		20,868			21,207
22	46,952,494	20,879	52	27,583,754	21,219
23	46,973,373	20,890	53	47,604,973	21,230
24	46,994,263		54	47,626,203	
		20,901			21,242
25	47,015,164	20,912	55	47,647,445	21,254
26	47,036,076	20,923	56	47,668,699	21,265
27	47,056,999		57	47,689,964	
		20,934			21,277
28	47,077,923	20,946	58	47,711,241	21,288
29	47,098,879	20,957	59	47,732,529	21,300
30	47,119,836		60	47,753,829	

62 Degr.			62 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	47,753,829		30	48,398,317	
		21,312			21,668
1	47,775,141		31	48,419,985	
		21,323			21,681
2	47,796,464		32	48,441,666	
		21,335			21,693
3	47,817,799		33	48,463,359	
		21,347			21,705
4	47,839,146		34	48,485,064	
		21,358			21,717
5	47,860,504		35	48,506,781	
		21,370			21,729
6	47,881,874		36	48,528,510	
		21,382			21,741
7	47,903,256		37	48,550,251	
		21,394			21,754
8	47,924,650		38	48,572,005	
		21,406			21,766
9	47,946,056		39	48,593,771	
		21,417			21,778
10	47,967,473		40	48,615,549	
		21,429			21,790
11	47,988,902		41	48,637,339	
		21,441			21,803
12	48,010,343		42	48,659,142	
		21,453			21,815
13	48,031,796		43	48,680,957	
		21,465			21,827
14	48,053,261		44	48,702,784	
		21,476			21,840
15	48,074,737		45	48,724,624	
		21,488			21,852
16	48,096,225		46	48,746,476	
		21,500			21,864
17	48,117,725		47	48,768,340	
		21,512			21,877
18	48,139,237		48	48,790,217	
		21,524			21,889
19	48,160,761		49	48,812,106	
		21,536			21,901
20	48,182,297		50	48,834,017	
		21,548			21,914
21	58,203,845		51	48,855,821	
		21,560			21,926
22	48,225,405		52	48,877,747	
		21,572			21,939
23	48,246,977		53	48,899,686	
		21,584			21,951
24	48,268,561		54	48,921,637	
		21,596			21,964
25	48,290,157		55	48,943,601	
		21,608			21,976
26	48,311,765		56	48,965,557	
		21,620			21,989
27	48,333,385		57	48,987,566	
		21,632			22,001
28	48,355,017		58	49,009,567	
		21,644			22,014
29	48,376,661		59	49,031,581	
		21,656			22,026
30	48,398,317		60	49,053,607	

63 Degr.			63 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	49,053,607		30	49,720,324	
		22,039			22,424
1	49,075,646		31	49,742,748	
		22,052			22,437
2	49,097,698		32	49,765,185	
		22,064			22,450
3	49,119,762		33	49,787,635	
		22,077			22,464
4	49,141,839		34	49,810,099	
		22,089			22,477
5	49,163,928		35	49,832,576	
		22,102			22,490
6	49,186,030		36	49,855,066	
		22,115			22,503
7	49,208,145		37	49,877,568	
		22,128			22,516
8	49,230,273		38	49,900,084	
		22,140			22,529
9	49,252,413		39	49,922,613	
		22,153			22,543
10	49,274,566		40	49,945,156	
		22,166			22,556
11	49,296,732		41	49,967,712	
		22,178			22,569
12	49,318,910		42	49,990,281	
		22,191			22,583
13	49,341,101		43	50,012,864	
		22,204			22,596
14	49,363,305		44	50,035,460	
		22,217			22,609
15	49,385,522		45	50,058,069	
		22,230			22,623
16	49,407,752		46	50,080,692	
		22,243			22,636
17	49,429,995		47	50,103,328	
		22,255			22,649
18	49,452,250		48	50,125,977	
		22,268			22,663
19	49,474,518		49	50,148,640	
		22,281			22,676
20	49,496,799		50	50,171,316	
		22,294			22,690
21	49,519,093		51	50,194,006	
		22,307			22,703
22	49,541,400		52	50,216,709	
		22,320			22,716
23	49,563,720		53	50,239,425	
		22,333			22,730
24	49,586,053		54	50,262,155	
		22,346			22,743
25	49,608,399		55	50,284,898	
		22,359			22,757
26	49,630,758		56	50,307,655	
		22,372			22,770
27	49,653,130		57	50,330,425	
		22,385			22,784
28	49,675,515		58	50,353,209	
		22,398			22,798
29	49,697,913		59	50,376,007	
		22,411			22,811
30	49,720,324		60	50,398,818	

64 Degr.			64 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	50,398,818		30	51,089,566	
		22,825			23,242
1	50,421,643		31	51,112,808	
		22,838			23,256
2	50,444,461		32	51,136,064	
		22,852			23,270
3	50,467,313		33	51,159,334	
		22,866			23,285
4	50,490,179		34	51,182,619	
		22,879			23,299
5	50,513,058		35	51,205,918	
		22,893			23,313
6	50,535,951		36	51,229,233	
		22,907			23,327
7	50,558,858		37	51,252,560	
		22,921			23,342
8	50,581,779		38	51,275,902	
		22,934			23,356
9	50,604,713		39	51,299,258	
		22,948			23,370
10	50,627,661		40	51,322,628	
		22,962			23,385
11	50,650,623		41	51,346,013	
		22,976			23,399
12	50,673,599		42	51,369,412	
		22,990			23,414
13	50,696,589		43	51,392,826	
		23,003			23,428
14	50,719,592		44	51,416,254	
		23,017			23,442
15	50,742,609		45	51,439,696	
		23,031			23,457
16	50,765,660		46	51,463,153	
		23,045			23,471
17	50,788,705		47	51,486,624	
		23,059			23,486
18	50,811,764		48	51,510,110	
		23,073			23,500
19	50,834,837		49	51,533,610	
		23,087			23,515
20	50,857,924		50	51,557,125	
		23,101			23,529
21	50,881,025		51	51,580,654	
		23,115			23,544
22	50,904,140		52	51,604,198	
		23,129			23,559
23	50,927,269		53	51,627,757	
		23,143			23,573
24	50,950,412		54	51,651,330	
		23,157			23,588
25	50,973,569		55	51,674,918	
		23,171			23,603
26	50,996,740		56	51,698,521	
		23,185			23,617
27	51,019,925		57	51,722,138	
		23,199			23,632
28	51,043,124		58	51,745,770	
		23,214			23,647
29	51,066,338		59	51,769,417	
		23,228			23,662
30	51,089,566		60	51,793,079	

65 Degr.			65 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	51,793,079		30	52,509,884	
		23,676			24,129
1	51,816,755	23,691	31	52,534,013	24,145
2	51,840,446	23,706	32	52,558,158	24,160
3	51,864,152		33	52,582,318	
		23,721			24,175
4	51,887,873	23,736	34	52,606,493	24,191
5	51,911,609	23,750	35	52,630,684	24,206
6	51,935,359		36	52,654,890	
		23,765			24,222
7	51,959,124	23,780	37	52,679,112	24,238
8	51,982,904	23,795	38	52,703,350	24,253
9	52,006,699		39	52,727,603	
		23,810			24,269
10	52,030,509	23,825	40	52,751,872	24,284
11	52,054,334	23,840	41	52,776,156	24,300
12	52,078,174		42	52,800,456	
		23,855			24,316
13	52,102,029	23,870	43	52,824,772	24,331
14	52,125,899	23,885	44	52,849,103	24,347
15	52,149,784		45	52,873,450	
		23,900			24,363
16	52,173,684	23,915	46	52,897,813	24,379
17	52,197,599	23,931	47	52,922,192	24,394
18	52,221,530		48	52,946,586	
		23,946			24,410
19	52,245,476	23,961	49	52,970,996	24,426
20	52,269,437	23,976	50	52,995,422	24,442
21	52,293,413		51	53,019,864	
		23,991			24,458
22	52,317,404	24,006	52	53,044,322	24,474
23	52,341,410	24,022	53	53,068,796	24,489
24	52,365,432		54	53,093,285	
		24,037			24,505
25	52,389,469	24,052	55	53,117,790	24,521
26	52,413,521	24,068	56	53,142,311	24 537
27	52,437,589		57	53,166,848	
		24,083			24,553
28	52,461,672	24,098	58	53,191,401	24,569
29	52,485,770	24,114	59	53,215,970	24,585
30	52,509,884		60	53,240,555	

66 Degr.			66 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	53,240,555	24,602	30	53,985,698	25,095
1	53,265,157	24,618	31	54,010,793	25,112
2	53,289,775	24,634	32	54,035,905	25,128
3	53,314,409	24,650	33	54,061,033	25,145
4	53,339,059	24,666	34	54,086,178	25,162
5	53,363,725	24,682	35	54,111,340	25,179
6	53,388,407	24,698	36	54,136,519	25,196
7	53,413,105	24,715	37	54,161,715	25,213
8	53,437,820	24,731	38	54,186,928	25,230
9	53,462,551	24,747	39	54,212,158	25,247
10	53,487,298	24,764	40	54,237,405	25,264
11	53,512,062	24,780	41	54,262,669	25,281
12	53,536,842	24,796	42	54,287,950	25,298
13	53,561,638	24,813	43	54,313,248	25,315
14	53,586,451	24,829	44	54,338,563	25,332
15	53,611,280	24,845	45	54,363,895	25,350
16	53,636,125	24,862	46	54,389,245	25,367
17	53,660,987	24,878	47	54,414,612	25,384
18	53,685,865	24,895	48	54,439,996	25,401
19	53,710,760	24,911	49	54,465,397	25,418
20	53,735,671	24,928	50	54,490,815	25,436
21	53,760,599	24,944	51	54,516,251	25,453
22	53,785,543	24,961	52	54,541,704	25,470
23	53,810,514	24,978	53	54,567,174	25,488
24	53,835,482	24,994	54	54,592,662	25,505
25	53,860,476	25,011	55	54,618,167	25,523
26	53,885,487	25,028	56	54,643,690	25,540
27	53,910,515	25,044	57	54,669,230	25,558
28	53,935,559	25,061	58	54,694,788	25,575
29	53,960,620	25,078	59	54,720,363	25,593
30	53,985,698		60	54,745,956	

67 Degr.			67 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	54,745,956		30	55,522,017	
		25,610			26,149
1	54,771,566		31	55,548,166	
		25,628			26,168
2	54,797,194		32	55,574,334	
		25,645			26,186
3	54,822,839		33	55,600,520	
		25,663			26,204
4	54,848,502		34	55,626,724	
		25,681			26,223
5	54,874,183		35	55,652,947	
		25,698			26,241
6	54,899,881		36	55,679,188	
		25,716			26,260
7	54,925,597		37	55,705,448	
		25,734			26,278
8	54,951,331		38	55,731,726	
		25,751			26,297
9	54,977,082		39	55,758,023	
		25,769			26,316
10	55,002,851		40	55,784,339	
		25,787			26,334
11	55,028,638		41	55,810,673	
		25,805			26,353
12	55,054,443		42	55,837,026	
		25,823			26,372
13	55,080,266		43	55,863,398	
		25,841			26,390
14	55,106,107		44	55,889,788	
		25,859			26,409
15	55,131,966		45	55,916,197	
		25,877			26,428
16	55,157,843		46	55,942,625	
		25,895			26,447
17	55,183,738		47	55,969,072	
		25,913			26,466
18	55,209,651		48	55,995,538	
		25,931			26,485
19	55,235,562		49	56,022,023	
		25,949			26,503
20	55,261,521		50	56,048,526	
		25,967			26,522
21	55,287,498		51	56,075,048	
		25,985			26,541
22	55,313,483		52	56,101,589	
		26,003			26,560
23	55,339,486		53	56,128,149	
		26,021			26,579
24	55,365,507		54	56,154,728	
		26,039			26,598
25	55,391,546		55	56,181,326	
		26,058			26,618
26	55,417,604		56	56,207,944	
		26,076			26,637
27	55,443,680		57	56,234,581	
		26,094			26,656
28	55,469,774		58	56,261,237	
		26,112			26,675
29	55,495,886		59	56,287,912	
		26,131			26,694
30	55,522,017		60	56,314,606	

68 Degr.			68 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	56,314,606		30	57,124,510	
		26,713			27,305
1	56,341,319		31	57,151,815	
		26,733			27,325
2	56,368,052		32	57,179,140	
		26,752			27,345
3	56,394,804		33	57,206,485	
		26,771			27,365
4	56,421,575		34	57,233,850	
		26,791			27,386
5	76,448,366		35	57,261,236	
		26,810			27,406
6	56,475,176		36	57,288,642	
		26,829			27,426
7	56,502,005		37	57,316,068	
		26,849			27,447
8	56.528,854		38	57,343,515	
		26,868			27,467
9	56,555,722		39	57,370,982	
		26,888			27,488
10	56,582,610		40	57,398,470	
		26,907			27,508
11	56,609,517		41	57,425,978	
		26,927			27,529
12	56,636,444		42	57,453,507	
		26,947			27,549
13	56,663,391		43	57,481,056	
		26,966			27,570
14	56,690,357		44	57,508,626	
		26,986			27,590
15	56,717,343		45	53,536,216	
		27,006			27,611
16	56,744,349		46	57,563,827	
		27,025			27,632
17	56,771,374		47	57,591,459	
		27.045			27,652
18	56,798,419		48	57,619,111	
		27,065			27,673
19	56,825,484		49	57,646,784	
		27,085			27,694
20	56,852,569		50	57,674,478	
		27,104			27,715
21	56,879,673		51	57,702,193	
		27,124			27,736
22	56,906,797		52	57,729,929	
		27,144			27,757
23	56,933,941		53	57,757,686	
		27,164			27,778
24	56,961,105		54	57,785,464	
		27,184			27,798
25	56,988,289		55	57,813,262	
		27,204			27,819
26	57,015,493		56	57,841,081	
		27.224			27,841
27	57,042,717		57	57,868,922	
		27,244			27,862
28	57,069,961		58	57,896,784	
		27,264			27,883
29	57,097,225		59	57,924,667	
		27,285			27,904
30	57,124,510		60	57,952,571	

69 Degr.			69 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	57,952,571		30	58,799,682	
1	57,980,496	27,925	31	58,828,258	28,576
2	58,008,442	27,946	32	58,856,857	28,599
3	58,036,409	27,967	33	58,885,478	28,621
4	58,064,398	27,989	34	58,914,121	28,643
5	58,092,408	28,010	35	58,942,787	28,666
6	58,120,439	28,031	36	58,971,475	28,688
7	58,148,492	28,053	37	59,000,185	28,710
8	58,176,566	28,074	38	59,028,918	28,733
9	58,204,661	28,095	39	59,057,673	28,755
10	58,232,778	28,117	40	59,086,451	28,778
11	58,260,916	28,138	41	59,115,252	28,801
12	58,289,076	28,160	42	59,144,075	28,823
13	58,317,258	28,182	43	59,172,921	28,846
14	58,345,461	28,203	44	59,201,790	28,869
15	58,373,686	28,225	45	59,230,681	28,891
16	58,401,933	28,247	46	59,259,595	28,914
17	58,430,201	28,268	47	59,288,532	28,937
18	58,458,491	28,290	48	59,317,492	28,960
19	58,486,803	28,312	49	59,346,475	28,983
20	58,515,137	28,334	50	59,375,481	29,006
21	58,543,493	28,356	51	59,404,510	29,029
22	58,571,870	28,377	52	59,433,562	29,052
23	58,600,269	28,399	53	59,462,637	29,075
24	58,628,690	28,421	54	59,491,735	29,098
25	58,657,133	28,443	55	59,520,856	29,121
26	58,685,598	28,465	56	59,550,000	29,144
27	58,714,086	28,488	57	59,579,168	29,168
28	58,742,596	28,510	58	59,608,359	29,191
29	58,771,128	28,532	59	59,637,573	29,214
30	58,799,682	28,554	60	59,666,811	29,238

70 Degr.			70 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	59,666,811	29,261	30	60,555,005	29,982
1	59,696,072	29,284	31	60,584,987	30,006
2	59,725,356	29,308	32	60,614,993	30,031
3	59,754,664	29,331	33	60,645,024	30,056
4	59,783,995	29,355	34	60,675,080	30,081
5	59,813,350	29,378	35	60,705,161	30,105
6	59,842,728	29,402	36	60,735,266	30,130
7	59,872,130	29,426	37	60,765,396	30,155
8	59,901,556	99,449	38	60,795,551	30,180
9	59,931,015	29,473	39	60,825,731	30,205
10	59,960,488	29,497	40	60,855,936	30,230
11	59,989,985	29,521	41	60,886,166	30,255
12	60,019,506	29,545	42	60,916,421	30,281
13	60,049,051	29,569	43	60,946,702	30,306
14	60,078,620	29,593	44	60,977,008	30,331
15	60,108,213	29,617	45	61,007,339	30,356
16	60,137,830	29,641	46	61,037,695	30,382
17	60,167,471	29,665	47	61,068,077	30,407
18	60,197,136	29,689	48	61,098,484	30,432
19	60,226,825	29,713	49	61,128,916	30,458
20	60,256,538	29,737	50	61,159,374	30,483
21	60,286,275	29,761	51	61,189,857	30,509
22	60,316,036	29,786	52	61,220,366	30,535
23	60,345,822	29,810	53	61,250,901	30,560
24	60,375,632	29,834	54	61,281,461	30,586
25	60,405,466	29,859	55	61,311,947	30,612
26	60,435,325	29,883	56	61,342,559	30,637
27	60,465,208	29,908	57	61,373,196	30,663
28	60,495,116	29,932	58	61,403,859	30,689
29	60,525,048	29,957	59	61,434,548	30,715
30	60,555,005		60	61,465,263	

71 Degr.			71 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	61,465,263		30	62,399,003	
		30,741			31,542
1	61,496,004	30,767	31	62,430,545	31,570
2	61,526,771	30,793	32	62,462,115	31,597
3	61,557,564		33	62,493,712	
		30,819			31,625
4	61,588,383	30,845	34	62,525,337	31,653
5	61,619,228	30,872	35	62,556,990	31,680
6	61,650,100		36	62,588,670	
		30,898			31,708
7	61,680,998	30,924	37	62,620,378	31,736
8	61,711,922	30,950	38	62,652,114	31,764
9	61,742,872		39	62,683,878	
		30,977			31,791
10	61,773,849	31,003	40	62,715,669	31,819
11	61,804,852	31,030	41	62,747,478	31,847
12	61,835,882		42	62,779,335	
		31,056			31,875
13	61,866,938	31,083	43	62,811,210	31,904
14	61,898,021	31,110	44	62,843,114	31,932
15	61,929,131		45	62,875,046	
		31,136			31,960
16	61,960,267	31,163	46	62,907,006	31,988
17	61,991,430	31,190	47	62,938,994	32,016
18	62,022,620		48	62,971,010	
		31,217			32,045
19	62,053,837	31,243	49	63,003,055	32,073
20	62,085,080	31,270	50	63,035,128	32,102
21	62,116,350		51	63,067,230	
		31,297			32,130
22	62,147,647	31,324	52	63,099,360	32,159
23	62,178,971	31,351	53	63,131,519	32,187
24	62,210,322		54	63,163,706	
		31,379			32,216
25	62,241,701	31,406	55	63,195,922	32,245
26	62,273,097	31,433	56	63,228,167	32,274
27	62,304,540		57	63,260,441	
		31,460			32,302
28	62,336,000	31,488	58	63,292,743	32,331
29	62,367,488	31,515	59	63,325,074	32,360
30	62,399,003		60	63,357,434	

72 Degr.			72 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	63,357,434		30	64,341,976	
		32,389			33,285
1	63,389,823		31	64,375,261	
		32,418			33,316
2	63,422,241		32	64,408,577	
		32,447			33,347
3	63,454,688		33	64,441,924	
		32,477			33,378
4	63,487,165		34	64,475,302	
		32,506			33,409
5	63,519,671		35	64,508,711	
		32,535			33,440
6	63,552,206		36	64,542,171	
		32,564			33,471
7	63,584,770		37	64,575,622	
		32,594			33,502
8	63,617,364		38	64,609,124	
		32,623			33,533
9	63,649,987		39	64,642,657	
		32,653			33,564
10	63,682,640		40	64,676,221	
		32,682			33,596
11	63,715,322		41	64,709,817	
		32,712			33,627
12	63,748,034		42	64,743,444	
		32,741			33,658
13	63,780,775		43	64,777,102	
		32,771			33,690
14	63,813,546		44	64,810,792	
		32,801			33,722
15	63,846,347		45	64,844,514	
		32,831			33,753
16	63,879,178		46	64,878,267	
		32,861			33,785
17	63,912,039		47	64,912,052	
		32,891			33,817
18	63,944,930		48	64,945,869	
		32,921			33,848
19	63,977,851		49	64,979,717	
		32,951			33,880
20	64,010,802		50	65,013,597	
		32,981			33,912
21	64,043,783		51	65,047,509	
		33,011			33,944
22	64,076,794		52	65,081,453	
		33,041			33,976
23	64,109,835		53	65,115,429	
		33,072			34,008
24	64,142,907		54	65,149,437	
		33,102			34,041
25	64,176,009		55	65,183,478	
		33,132			34,073
26	64,209,141		56	65,217,551	
		33,163			34,105
27	64,242,304		57	65,251,656	
		33,193			34,138
28	64,275,497		58	65,285,794	
		33,224			34,170
29	64,308,721		59	65,319,964	
		33,255			34,203
30	64,341,976		60	65,354,167	

73 Degr.			73 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	65,354,167		30	66,395,690	
		34,235			35,243
1	65,388,402	34,268	31	66,430,933	35,278
2	65,422,670	34,300	32	66,466,211	35,313
3	65,456,970		33	66,501,524	
		34,333			35,348
4	65,491,303	34,366	34	66,536,872	35,383
5	65,525,669	34,399	35	66,572,255	35,418
6	65,560,068		36	66,607,673	
		34,432			35,453
7	65,594,500	34,465	37	66,643,126	35,488
8	65,628,965	34,498	38	66,678,614	35,523
9	65,663,463		39	66,714,137	
		34,531			35,558
10	65,697,994	34,564	40	66,749,695	35,594
11	65,732,558	34,598	41	66,785,289	35,629
12	65,767,156		42	66,820,918	
		34,631			35,664
13	65,801,787	34,665	43	66,856,582	35,700
14	65,836,452	34,698	44	66,892,282	35,736
15	65,871,150		45	66,928,018	
		34,732			35,771
16	65,905,882	34,765	46	66,963,789	35,807
17	65,940,647	34,799	47	66,999,596	35,843
18	65,975,446		48	67,035,439	
		34,833			35,879
19	66,010,279	34,867	49	67,071,318	35,915
20	66,045,146	34,901	50	67,107,233	35,951
21	66,080,047		51	67,143,184	
		34,935			35,987
22	66,114,982	34,969	52	67,179,171	36,023
23	66,149,951	35,003	53	67,215,194	36,060
24	66,184,954		54	67,251,254	
		35,037			36,096
25	66,219,991	35,071	55	67,287,350	36,132
26	66,255,062	35,105	56	67,323,482	36,169
27	66,290,167		57	67,359,651	
		35,140			36,206
28	66,325,307	35,174	58	67,395,857	36,242
29	66,360,481	35,209	59	67,432,099	36,279
30	66,395,690		60	67,468,378	

74 Degr.			74 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of qual parts.
0	67,468,378		30	68,574,239	
		36,316			37,459
1	67,504,694		31	68,611,698	
		36,353			37,498
2	67,541,047		32	68,649,196	
		36,390			37,537
3	67,577,437		33	68,686,733	
		36,427			37,577
4	67,613,864		34	68,724,310	
		36,464			37,617
5	67,650,328		35	68,761,927	
		36,501			37,656
6	67,686,829		36	68,799,583	
		36,539			37,696
7	67,723,368		37	68,837,279	
		36,576			37,736
8	67,759,944		38	68,874,915	
		36,613			37,776
9	67,796,557		39	68,912,791	
		36,651			37,816
10	67,833,208		40	68,950,607	
		36,689			37,856
11	67,869,897		41	68,988,463	
		36,726			37,897
12	67,906,623		42	69,026,360	
		36,764			37,937
13	67,943,387		43	69,064,297	
		36,802			37,977
14	67,980,189		44	69,102,274	
		36,840			38,018
15	68,017,029		45	69,140,292	
		36,878			38,058
16	68,053,907		46	69,178,350	
		36,916			38,099
17	68,090,823		47	69,216,449	
		36,954			38,140
18	68,127,777		48	69,254,589	
		36,993			38,181
19	68,164,770		49	69,292,770	
		37,031			38,222
20	68,201,801		50	69,330,992	
		37,069			38,263
21	68,238,870		51	69,369,255	
		37,108			38,304
22	68,275,978		52	69,407,559	
		37,147			38,345
23	68,313,125		53	69,445,904	
		37,185			38,387
24	68,350,310		54	69,484,291	
		37,224			38,428
25	68,387,534		55	69,522,719	
		37,263			38,470
26	68,424,797		56	69,561,189	
		37,302			38,511
27	68,462,099		57	69,599,700	
		37,341			38,553
28	68,499,440		58	69,638,253	
		37,380			38,595
29	68,536,820		59	69,676,848	
		37,419			38,637
30	68,574,239		60	69,715,485	

75 Degr.			75 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	69,715,485		30	70,894,564	
		38,679			39,984
1	69,754,164		31	70,934,548	
		38,721			40,029
2	69,792,885		32	70,974,577	
		38,763			40,074
3	69,831,648		33	71,014,651	
		38,805			40,119
4	69,870,453		34	71,054,770	
		38,847			40,165
5	69,909,300		35	71,094,935	
		38,890			40,210
6	69,948,190		36	71,135,145	
		38,932			40,256
7	69,987,142		37	71,175,401	
		38,975			40,302
8	70,026,117		38	71,215,703	
		39,018			40,347
9	70,065,135		39	71,256,051	
		39,061			40,393
10	70,104,196		40	71,296,444	
		39,104			40,439
11	70,143,300		41	71,336,883	
		39,147			40,485
12	70,182,447		42	71,377,358	
		39,190			40,532
13	70,221,637		43	71,417,900	
		39,233			40,578
14	70,260,870		44	71,458,478	
		39,277			40,625
15	70,300,147		45	71,499,103	
		39,320			40,671
16	70,339,467		46	71,539,774	
		39,363			40,718
17	70,378,830		47	71,580,492	
		39,407			40,765
18	70,418,237		48	71,621,257	
		39,451			40,812
19	70,457,688		49	71,662,069	
		39,495			40,859
20	70,497,183		50	71,702,928	
		39,539			40,906
21	70,536,722		51	71,743,834	
		39,583			40,953
22	70,576,305		52	71,784,787	
		39,627			41,000
23	70,615,932		53	71,825,787	
		39,671			41,048
24	70,655,603		54	71,866,835	
		39,715			41,095
25	70,695,318		55	71,907,930	
		39,760			41,143
26	70,735,078		56	71,949,073	
		39,804			41,191
27	70,774,882		57	71,990,264	
		39,849			41,239
28	70,814,731		58	72,031,503	
		39,894			41,287
29	70,854,625		59	72,072,790	
		39,939			41,335
30	70,894,564		60	72,114,125	

76 Degr.			76 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	72,114,125		30	73,377,167	
		41,383			42,888
1	72,155,508		31	73,420,055	
		41,432			42,940
2	72,196,940		32	73,462,995	
		41,480			42,992
3	72,238,420		33	73,505,987	
		41,529			43,045
4	72,279,949		34	73,549,032	
		41,578			43,097
5	72,321,527		35	73,592,129	
		41,627			43,150
6	72,363,154		36	73,635,279	
		41,676			43,203
7	72,404,830		37	73,678,482	
		41,725			43,255
8	72,446,555		38	73,721,737	
		41,774			43,309
9	72,488,329		39	73,765,046	
		41,823			43,362
10	72,530,152		40	73,808,408	
		41,873			43,415
11	72,572,025		41	73,851,823	
		41,922			43,468
12	72,613,947		42	73,895,291	
		41,972			43,522
13	72,655,919		43	73,938,813	
		42,022			43,576
14	72,697,941		44	73,982,389	
		42,072			43,629
15	72,740,013		45	74,026,018	
		42,122			43,683
16	72,782,135		46	74,069,701	
		42,172			43,738
17	72,824,307		47	74,113,439	
		42,222			43,792
18	72,866,529		48	74,157,231	
		42,273			43,846
19	72,908,802		49	74,201,077	
		42,323			43,901
20	72,951,125		50	74,244,978	
		42,374			43,955
21	72,993,499		51	74,288,933	
		42,425			44,010
22	73,035,924		52	74,332,943	
		42,476			44,065
23	73,078,400		53	74,377,008	
		42,527			44,120
24	73,120,927		54	74,421,128	
		42,578			44,175
25	73,163,505		55	74,465,303	
		42,629			44,231
26	73,206,134		56	74,509,534	
		42,681			44,286
27	73,248,815		57	74,553,820	
		42,732			44,342
28	73,291,547		58	74,598,162	
		42,784			44,398
29	73,334,331		59	74,642,560	
		42,836			44,454
30	73,377,167		60	74,687,014	

77 Degr.			77 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	74,687,014		30	76,047,374	
		44,510			46,262
1	74,731,524	44,566	31	76,093,636	46,323
2	74,776,090	44,622	32	76,139,959	46,384
3	74,820,712		33	76,186,343	
		44,679			46,446
4	74,865,391	44,735	34	76,232,789	46,507
5	74,910,126	44,792	35	76,279,296	46,568
6	74,954,918		36	76,325,864	
		44,849			46,630
7	74,999,767	44,906	37	76,372,394	46,692
8	750,446,73	44,964	38	76,419,186	46,754
9	75,089,637		39	76,465,940	
		45,021			46,816
10	75,134,658	45,079	40	76,512,756	46,879
11	75,179,737	45,136	41	76,559,635	46,941
12	75,224,873		42	76,606,576	
		45,194			47,004
13	75,270,067	45,252	43	76,653,580	47,067
14	75,315,319	45,310	44	75,700,647	47,130
15	75,360,629		45	76,747,777	
		45,369			47,193
16	75,405,998	45,427	46	76,794,970	47,256
17	75,451,425	45,486	47	76,842,226	47,320
18	75,496,911		48	76,889,546	
		45,545			47,384
19	75,542,456	45,604	49	76,936,930	47,448
20	75,588,060	45,663	50	76,984,378	47,512
21	75,633,723		51	77,031,890	
		45,722			47,576
22	75,679,445	45,781	52	77,079,466	77,641
23	75,725,226	45,841	53	77,127,107	47,705
24	57,771,067		54	77,174,812	
		45,901			47,770
25	75,816,968	45,961	55	77,222,582	47,835
26	75,862,929	46,021	56	77,270,417	47,900
27	75,908,950		57	77,318,317	
		46,081			47,966
28	75,955,031	46,141	58	77,366,283	48,031
29	76,001,172	46,202	59	77,414,314	48,097
30	76,047,374		60	77,462,411	

78 Degr.			78 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	77,462,411		30	78,936,821	
		48,163			50,230
1	77,510,574		31	78,987,051	
		48,229			50,302
2	77,558,803		32	79,037,353	
		48,295			50,374
3	77,607,098		33	79,087,727	
		48,362			50,447
4	77,655,460		34	79,138,174	
		48,428			50,519
5	77,703,888		35	79,188,693	
		48,495			50,592
6	77,752,383		36	79,239,285	
		48,562			50,665
7	77,800,945		37	79,289,950	
		48,629			50,739
8	77,849,574		38	79,340,689	
		48,697			50,812
9	77,898,271		39	79,391,501	
		48,764			50,886
10	77,947,035		40	79,442,387	
		48,832			50,960
11	77,995,867		41	79,493,347	
		48,900			51,034
12	78,044,767		42	79,544,381	
		48,968			51,108
13	78,093,735		43	79,595,489	
		49,037			51,183
14	78,142,772		44	79,646,672	
		49,105			51,258
15	78,191,877		45	79,697,930	
		49,174			51,333
16	78,241,051		46	79,749,263	
		49,243			51,408
17	78,290,294		47	79,800,671	
		49,312			51,484
18	78,339,606		48	79,852,155	
		49,382			51,559
19	78,388,988		49	79,903,714	
		49,451			51,635
20	78,438,439		50	79,955,349	
		49,521			51,712
21	78,487,960		51	80,007,061	
		49,591			51,788
22	78,537,551		52	80,058,849	
		49,661			51,865
23	78,587,212		53	80,110,714	
		49,731			51,942
24	78,636,943		54	80,162,656	
		49,802			52,019
25	78,686,745		55	80,214,675	
		49,873			52,096
26	78,736,618		56	80,266,771	
		49,944			52,174
27	78,876,592		57	80,318,945	
		50,015			52,252
28	78,836,577		58	80,371,197	
		50,086			52,330
29	78,886,663		59	80,423,527	
		50,158			52,408
30	78,936,821		60	80,475,935	

79 Degr.			79 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	80,475,935		30	82,085,813	
1	80,528,421	52,486	31	82,140,773	54,960
2	80,580,986	52,565	32	82,195,819	55,046
3	80,633,630	52,644	33	82,250,952	55,133
4	80,686,354	52,724	34	82,306,172	55,220
5	80,739,157	52,803	35	82,361,480	55,308
6	80,792,040	52,883	36	82,416,875	55,395
7	80,845,003	52,963	37	82,472,358	55,483
8	80,898,046	53,043	38	82,527,929	55,571
9	80,951,170	53,124	39	82,583,589	55,660
10	81,004,374	53,204	40	82,639,338	55,749
11	81,057,659	53,285	41	82,695,176	55,838
12	81,111,026	53,367	42	82,751,103	55,927
13	81,164,474	53,448	43	82,807,120	56,017
14	81,218,004	53,530	44	82,863,227	56,107
15	81,271,616	53,612	45	82,919,424	56,197
16	81,325,310	53,694	46	82,975,712	56,288
17	81,379,087	53,777	47	83,032,090	56,378
18	81,432,946	53,859	48	83,088,560	56,470
19	81,486,889	53,943	49	83,145,121	56,561
20	81,540,915	54,026	50	83,201,774	56,653
21	81,595,024	54,109	51	83,258,519	56,745
22	81,649,217	54,193	52	83,315,356	56,837
23	81,703,494	54,277	53	83,372,286	56,930
24	81,757,856	54,362	54	83,429,309	57,023
25	81,812,302	54,446	55	83,486,425	57,116
26	81,866,833	54,531	56	83,543,635	57,210
27	81,921,449	54,616	57	83,600,939	57,304
28	81,976,151	54,702	58	83,658,337	57,398
29	82,030,939	54,788	59	83,715,829	57,492
30	82,085,813	54,874	60	83,773,416	57,587

80 Degr.			80 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	83,773,416		30	85,546,774	
		57,682			60,694
1	83,831,098		31	85,607,468	
		57,778			60,799
2	83,888,876		32	85,668,267	
		57,874			60,906
3	83,946,750		33	85,729,173	
		57,970			61,012
4	84,004,720		34	85,790,185	
		58,066			61,119
5	84,062,786		35	85,851,304	
		58,163			61,227
6	84,120,949		36	85,912,531	
		58,260			61,335
7	84,179,209		37	85,973,866	
		58,358			61,443
8	84,237,567		38	86,035,209	
		58,455			61,551
9	84,296,022		39	86,096,860	
		58,553			61,660
10	84,354,575		40	86,158,520	
		58,652			61,770
11	84,413,227		41	86,220,290	
		58,751			61,879
12	84,471,978		42	86,282,169	
		58,850			61,989
13	84,530,828		43	86,344,158	
		58,949			62,100
14	84,589,777		44	86,406,258	
		59,049			62,211
15	84,648,826		45	86,468,469	
		59,149			62,322
16	84,707,975		46	86,530,791	
		59,250			62,434
17	84,767,225		47	85,593,225	
		59,350			62,546
18	84,826,575		48	86,655,771	
		59,452			62,658
19	84,886,027		49	86,718,429	
		59,553			62,771
20	84,945,580		50	86,781,200	
		59,655			62,885
21	85,005,235		51	86,844,085	
		59,757			62,999
22	85,064,992		52	86,907,084	
		59,860			63,113
23	85,124,852		53	86,970,197	
		59,962			63,227
24	85,184,815		54	87,033,424	
		60,066			63,342
25	85,244,881		55	87,096,766	
		60,170			63,458
26	85,305,051		56	87,160,224	
		60,274			63,574
27	85,365,325		57	87,223,798	
		60,378			63,690
28	85,425,703		58	87,287,488	
		60,483			63,807
29	85,486,186		59	87,351,295	
		60,588			63,924
30	85,546,774		60	87,415,219	

81 Degr.			81 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	87,415,219		30	89,389,688	
		64,042			67,786
1	87,479,261		31	89,457,474	
		64,160			67,919
2	87,543,421		32	89,525,393	
		64,278			68,052
3	87,607,699		33	89,593,445	
		64,397			68,185
4	87,672,096		34	89,661,630	
		64,517			68,319
5	87,736,613		35	89,729,949	
		64,636			68,454
6	87,801,249		36	89,798,403	
		64,757			68,589
7	87,866,006		37	89,866,992	
		64,877			68,724
8	87,930,883		38	89,935,716	
		64,999			68,861
9	87,995,882		39	90,004,577	
		65,120			68,997
10	88,061,002		40	90,073,574	
		65,242			69,135
11	88,126,244		41	90,142,709	
		65,365			69,273
12	88,191,609		42	90,211,982	
		65,488			69,411
13	88,257,097		43	90,281,393	
		65,612			69,550
14	88,322,709		44	90,350,943	
		65,736			69,689
15	88,388,445		45	90,420,632	
		65,860			69,830
16	88,454,305		46	90,490,462	
		65,985			69,970
17	88,520,290		47	90,560,432	
		66,110			70,111
18	88,586,400		48	90,630,543	
		66,236			70,253
19	88,652,636		49	90,700,796	
		66,363			70,396
20	88,718,999		50	90,771,192	
		66,490			70,539
21	88,785,489		51	90,841,731	
		66,617			70,682
22	88,852,106		52	90,912,413	
		66,745			70,826
23	88,918,851		53	90,983,239	
		66,873			70,971
24	88,985,724		54	91,054,210	
		67,002			71,117
25	89,052,726		55	91,125,327	
		67,132			71,263
26	89,119,858		56	91,196,590	
		67,261			71,409
27	89,187,119		57	91,267,999	
		67,392			71,556
28	89,254,511		58	91,339,555	
		67,523			71,704
29	89,322,034		59	91,411,259	
		67,654			71,852
30	89,389,688		60	91,483,111	

82 Degr.			82 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	91,483,111		30	93,710,914	
		72,001			76,782
1	91,555,113		31	93,787,706	
		72,151			76,953
2	91,627,264		32	93,864,659	
		72,301			77,124
3	91,699,565		33	93,941,783	
		72,452			77,296
4	91,772,017		34	94,019,079	
		72,604			77,468
5	91,844,621		35	94,096,547	
		72,756			77,642
6	91,917,377		36	94,174,189	
		72,909			77,816
7	91,990,286		37	94,252,005	
		73,062			77,991
8	92,063,348		38	94,329,996	
		73,217			78,167
9	92,136,565		39	94,408,163	
		73,371			78,344
10	92,209,936		40	94,486,507	
		73,527			78,521
11	92,283,463		41	94,565,028	
		73,683			78,700
12	92,357,146		42	94,643,728	
		73,840			78,879
13	92,430,986		43	94,722,607	
		73,997			79,059
14	92,504,983		44	94,801,666	
		74,155			79,239
15	92,579,138		45	94,880,905	
		74,314			79,421
16	92,653,452		46	94,960,326	
		74,474			79,603
17	92,727,926		47	95,039,929	
		74,634			79,787
18	92,802,560		48	95,119,716	
		74,795			79,971
19	92,877,355		49	95,199,687	
		74,957			80,156
20	92,952,312		50	95,279,843	
		75,119			80,342
21	93,027,431		51	95,360,185	
		75,282			80,529
22	93,102,713		52	95,440,714	
		75,446			80,716
23	93,178,159		53	95,521,430	
		75,610			80,905
24	93,253,769		54	95,602,335	
		75,775			81,094
25	93,329,544		55	95,683,429	
		75,941			81,284
26	93,405,485		56	95,764,713	
		76,108			81,475
27	93,481,593		57	95,846,189	
		76,275			81,668
28	93,557,868		58	95,927,857	
		76,444			81,861
29	93,634,312		59	96,009,718	
		76,612			82,055
30	93,710,914		60	96,091,773	

83 Degr.			83 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	96,091,773		30	98,648,445	
		82,249			88,562
1	96,174,022		31	98,737,007	
		82,445			88,790
2	96,256,467		32	98,825,797	
		82,642			89,018
3	96,339,009		33	98,914,815	
		82,840			89,248
4	96,421,949		34	99,004,063	
		83,038			89,479
5	96,504,987		35	99,093,542	
		83,238			89,711
6	96,588,225		36	99,183,253	
		83,439			89,944
7	96,671,664		37	99,273,197	
		83,640			90,178
8	96,755,304		38	99,363,375	
		83,843			90,414
9	96,839,147		39	99,453,789	
		84,046			90,651
10	96,923,193		40	99,544,440	
		84,251			90,889
11	97,007,444		41	99,635,329	
		84,456			91,129
12	97,091,900		42	99,726,458	
		84,663			91,369
13	97,176,563		43	99,817,827	
		84,870			91,611
14	97,261,433		44	99,909,438	
		85,079			91,855
15	97,346,512		45	100,001,293	
		85,288			92,099
16	97,431,800		46	100,093,392	
		85,499			92,345
17	97,517,299		47	100,185,737	
		85,711			92,593
18	97,603,010		48	100,278,330	
		85,924			92,841
19	97,688,934		49	100,371,171	
		86,137			93,091
20	97,775,071		50	100,464,262	
		86,352			93,342
21	97,861,423		51	100,557,604	
		86,568			93,595
22	97,947,991		52	100,651,199	
		86,785			93,849
23	98,034,776		53	100,745,048	
		87,004			94,105
24	98,121,780		54	100,839,153	
		87,223			94,361
25	98,209,003		55	100,933,514	
		87,443			94,620
26	98,296,446		56	101,028,134	
		87,665			94,879
27	98,384,111		57	101,123,013	
		87,887			95,141
28	98,471,998		58	101,218,154	
		88,111			95,403
29	98,560,109		59	101,313,557	
		88,336			95,667
30	98,648,445		60	101,409,224	

84 Degr.			84 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	101,409,224		30	104,409,799	
		95,933			104,650
1	101,505,157		31	104,514,449	
		96,200			104,968
2	101,601,357		32	104,619,417	
		96,468			105,288
3	101,697,825		33	104,724,705	
		96,738			105,610
4	101,794,563		34	104,830,315	
		97,010			105,934
5	101,891,573		35	104,936,249	
		97,283			106,260
6	101,988,856		36	105,042,509	
		97,557			106,588
7	102,086,413		37	105,149,097	
		97,834			106,918
8	102,184,247		38	105,256,015	
		98,111			107,250
9	102,282,358		39	105,363,265	
		98,391			107,584
10	102,380,749		40	105,470,849	
		98,672			107,921
11	102,479,421		41	105,578,770	
		98,954			108,259
12	102,578,375		42	105,687,029	
		99,238			108,600
13	102,677,613		43	105,795,629	
		99,524			108,942
14	102,777,137		44	105,904,571	
		99,812			109,287
15	102,876,949		45	106,013,858	
		100,101			109,634
16	102,977,050		46	106,123,492	
		100,392			109,984
17	103,077,442		47	106,233,476	
		100,684			110,335
18	103,178,126		48	106,343,811	
		100,979			110,689
19	103,279,105		49	106,454,500	
		101,275			111,045
20	103,380,380		50	106,565,545	
		101,572			111,403
21	103,481,952		51	106,676,948	
		101,872			111,764
22	103,583,824		52	106,788,712	
		102,173			112,127
23	103,685,997		53	106,900,839	
		102,476			112,493
24	103,788,473		54	107,013,332	
		102,781			112,861
25	103,891,254		55	107,126,193	
		103,088			113,231
26	103,994,342		56	107,239,424	
		103,397			113,604
27	104,097,739		57	107,353,128	
		103,707			113,979
28	104,201,446		58	107,467,107	
		104,019			114,356
29	104,305,465		59	107,581,463	
		104,334			114,737
30	104,409,799		60	107,696,200	

85 Degr.			85 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	107,696,200		30	111,328,728	
		115,119			127,927
1	107,811,319		31	111,456,655	
		115,505			128,404
2	107,926,824		32	111,585,059	
		115,893			128,884
3	108,042,717		33	111,713,943	
		116,283			129,367
4	108,159,002		34	111,843,310	
		116,676			129,854
5	108,275,678		35	111,973,164	
		117,072			130,345
6	108,392,750		36	112,103,509	
		117,471			130,840
7	108,510,221		37	112,234,349	
		117,872			131,338
8	108,628,093		38	112,365,687	
		118,276			131,841
9	108,746,369		39	112,497,528	
		118,683			132,347
10	108,865,052		40	112,629,875	
		119,093			132,857
11	108,984,145		41	112,762,732	
		119,506			133,371
12	109,103,651		42	112,895,803	
		119,921			133,889
13	109,223,572		43	113,029,992	
		120,339			134,411
14	109,343,911		44	113,164,403	
		120,760			134,937
15	109,464,671		45	113,299,340	
		121,185			135,467
16	109,585,856		46	113,434,807	
		121,612			136,002
17	109,707,468		47	113,570,809	
		122,042			136,540
18	109,829,510		48	113,707,349	
		122,476			137,083
19	109,951,986		49	113,844,432	
		122,912			137,631
20	110,074,898		50	113,982,063	
		123,352			138,183
21	110,198,250		51	114,120,246	
		123,794			138,739
22	110,322,044		52	114,258,685	
		124,240			139,299
23	110,445,628		53	114,398,284	
		124,989			139,865
24	110,570,973		54	114,538,149	
		125,142			140,435
25	110,696,115		55	114,678,584	
		125,598			141,009
26	110,821,713		56	114,819,593	
		126,057			141,588
27	110,947,770		57	114,961,181	
		126,519			142,172
28	111,074,289		58	115,103,353	
		126,985			142,761
29	111,201,274		59	115,246,114	
		127,454			143,355
30	111,328,728		60	115,389,469	

86 Degr.			86 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	115,389,469	143,954	30	119,993,436	164,586
1	115,533,423	144,558	31	120,158,022	165,377
2	115,677,981	145,167	32	120,323,399	166,175
3	115,823,148	145,781	33	120,489,574	166,980
4	115,968,929	146,401	34	120,656,554	167,794
5	116,115,330	147,025	35	120,824,348	168,615
6	116,262,355	147,655	36	120,992,963	169,445
7	116,410,010	148,291	37	121,162,408	170,283
8	116,558,001	148,932	38	121,332,691	171,129
9	116,707,233	149,578	39	121,503,820	171,984
10	116,856,811	150,230	40	121,675,804	172,847
11	117,007,041	150,888	41	121,848,651	173,719
12	117,157,929	151,552	42	122,022,370	174,600
13	117,309,481	152,222	43	122,196,970	175,490
14	117,461,703	152,897	44	122,372,460	176,389
15	117,614,600	153,579	45	122,548,849	177,297
16	117,768,179	154,267	46	122,726,146	178,215
17	117,922,446	154,961	47	122,904,361	179,142
18	118,077,407	155,661	48	123,083,503	180,078
19	118,233,068	156,367	49	123,263,581	181,025
20	118,389,435	157,080	50	123,444,608	181,983
21	118,546,515	157,800	51	123,626,589	182,950
22	118,704,315	158,526	52	123,809,539	183,927
23	118,862,841	159,259	53	123,993,466	184,915
24	119,022,100	159,999	54	124,078,381	185,913
25	119,182,099	160,746	55	124,264,294	186,923
26	119,342,845	161,499	56	124,451,217	187,943
27	119,504,344	162,260	57	124,639,160	188,975
28	119,666,604	163,028	58	124,828,135	190,018
29	119,829,632	163,804	59	125,018,153	191,073
30	119,993,436		60	125,209,226	

87 Degr.			87 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	125,209,226		30	131,498,494	
		192,139			230,793
1	125,401,365		31	131,729,287	
		193,218			232,351
2	125,594,583		32	131,961,638	
		194,308			233,936
3	125,788,891		33	132,195,574	
		195,411			235,532
4	125,984,102		34	132,431,106	
		196,527			237,156
5	126,180,829		35	132,668,262	
		197,656			238,802
6	126,378,485		36	132,907,064	
		198,797			240,470
7	126,577,282		37	133,147,534	
		199,952			242,163
8	126,777,234		38	133,389,697	
		201,120			243,880
9	126,978,354		39	133,633,577	
		202,302			245,621
10	127,180,656		40	133,879,198	
		203,498			247,387
11	127,384,154		41	134,126,585	
		204,709			249,178
12	127,588,863		42	134,375,763	
		205,934			250,996
13	127,794,797		43	134,626,759	
		207,173			252,841
14	128,001,970		44	134,879,600	
		208,428			154,713
15	128,210,398		45	135,134,313	
		209,698			256,613
16	128,420,096		46	135,390,926	
		210,983			258,541
17	128,631,079		47	135,649,467	
		212,285			260,499
18	128,843,364		48	135,909,966	
		213,602			262,486
19	129,056,966		49	136,172,452	
		214,936			264,505
20	129,271,902		50	136,436,957	
		216,287			266,554
21	129,488,189		51	136,703,511	
		217,655			268,636
22	129,705,844		52	136,972,147	
		219,040			270,750
23	129,924,884		53	137,242,897	
		220,444			272,898
24	130,145,328		54	137,515,795	
		221,865			275,080
25	130,367,193		55	137,790,875	
		223,304			277,297
26	130,590,497		56	138,068,172	
		224,763			279,551
27	130,815,260		57	138,347,723	
		226,241			281,841
28	131,041,501		58	138,629,564	
		227,738			284,169
29	131,269,239		59	138,913,733	
		229,255			286,537
30	131,498,494		60	139,200,270	

88 Degr.			88 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	139,200,270		30	149,139,458	
		288,943			386,306
1	139,489,213		31	149,525,764	
		291,391			390,695
2	139,780,604		32	149,916,459	
		293,881			395,185
3	140,074,485		33	150,311,644	
		296,413			399,779
4	140,370,898		34	150,711,423	
		298,990			404,482
5	140,669,888		35	151,115,905	
		301,612			409,296
6	140,971,500		36	151,525,201	
		304,281			414,226
7	141,275,781		37	151,939,427	
		306,995			419,277
8	141,582,776		38	152,358,704	
		309,760			424,452
9	141,892,536		39	152,783,156	
		312,575			429,752
10	142,205,111		40	153,212,913	
		315,442			435,196
11	142,520,553		41	153,648,109	
		318,361			440,774
12	142,838,914		42	154,088,883	
		321,336			446,497
13	143,160,250		43	154,535,380	
		324,367			452,371
14	143,484,617		44	154,987,751	
		327,455			458,402
15	143,812,072		45	155,446,153	
		330,602			464,596
16	144,142,674		46	155,910,749	
		333,811			470,959
17	144,476,485		47	156,381,708	
		337,083			477,499
18	144,813,568		48	156,859,207	
		340,419			484,224
19	145,153,987		49	157,343,431	
		343,823			491,140
20	145,497,810		50	157,834,571	
		347,295			498,257
21	145,845,105		51	158,332,828	
		350,838			505,583
22	146,195,943		52	158,838,411	
		354,453			513,129
23	146,550,396		53	159,351,540	
		358,145			520,902
24	146,908,541		54	159,872,442	
		361,914			528,915
25	147,270,455		55	160,401,357	
		365,763			537,178
26	147,636,218		56	160,938,535	
		369,695			545,704
27	148,005,913		57	161,484,239	
		373,712			554,505
28	148,379,625		58	162,038,744	
		377,818			563,594
29	148,757,443		59	162,602,338	
		382,015			572,986
30	149,139,458		60	163,175,324	

89 Degr.			89 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	163,175,324		30	187,293,467	
		582,696			1,185,443
1	163,758,020		31	188,478,910	
		592,743			1,227,780
2	164,350,763		32	189,706,690	
		603,141			1,273,252
3	164,953,904		33	190,979,942	
		613,910			1,322,222
4	165,567,814		34	192,302,164	
		625,071			1,375,110
5	166,192,885		35	193,677,274	
		636,645			1,432,406
6	166,829,530		36	195,109,680	
		648,657			1,494,683
7	167,478,187		37	196,604,363	
		661,130			1,562,622
8	168,139,317		38	198,166,985	
		674,092			1,637,032
9	168,813,409		39	199,804,017	
		687,573			1,718,883
10	169,500,982		40	201,522,900	
		701,604			1,809,349
11	170,202,586		41	203,332,249	
		716,220			1,909,868
12	170,918,806		42	205,242,117	
		731,458			2,022,212
13	171,650,264		43	207,264,329	
		747,358			2,148,599
14	172,397,622		44	209,412,928	
		763,965			2,291,838
15	173,161,587		45	211,704,766	
		781,327			2,455,549
16	173,942,914		46	214,160,306	
		799,496			2,644,426
17	174,742,410		47	216,804,732	
		818,531			2,864,794
18	175,560,941		48	219,669,526	
		838,494			3,125,229
19	176,399,435		49	222,794,755	
		859,456			3,437,751
20	177,258,891		50	226,232,506	
		881,492			3,819,723
21	178,140,383		51	230,052,229	
		904,688			4,297,187
22	179,045,071		52	234,349,416	
		929,138			4,911,090
23	179,974,209		53	239,260,506	
		954,947			5,729,580
24	180,929,156		54	244,990,086	
		982,230			6,875,496
25	181,911,386		55	251,865,582	
		1,011,118			8,594,338
26	182,922,504		56	260,459,920	
		1,041,757			11,459,157
27	183,964,261		57	271,919,077	
		1,074,311			17,188,734
28	185,038,572		58	289,107,811	
		1,108,965			34,377,468
29	186,147,537		59	323,485,279	
		1,145,930			Infinite.
30	187,293,467		60	Infinite.	

60 357.862747

Chap. III.

The vse of the two first columnes of the Table of Latitudes, for graduating a meridian in the general Sea-Chart.

Before you can make vse of this Table, for the true graduating, or diuiding of a meridian of this Chart into his degrees, or other parts of Latitude, increasing from the æquinoctial towards the North and South in such proportion, as before hath been shewed, there must be first some preparation made to that end; which may be done after this manner: Ouerthwart the midst of the plaine superficies, whereupon you will draw the lineaments of the Chart, describe a right line, (representing the æquinoctial circle) which you shall diuide into 360 parts or degrees, and crosse the same squirewise with right lines, by euery fift or tenth degree. Then take with your compasses the length of halfe the æquinoctial, (that is, 180 degrees) and setting one foote of your compasses in the mutuall intersection of the æquinoctial, with the perpendicular or meridian that passeth by either end of the æquinoctial, with the other foote make a pricke in the same perpendicular or meridian: the space conteined betwixt this pricke and the æquinoctial, diuide first into three æquall parts, and euery one of these into other three, so haue you nine in all: and againe euery

euery one of these into three, so haue you 27 partes, and euery one of these parts diuide into foure, so haue you 108 parts: And againe (if there be space enough) diuide euery one of these into 10 or 100. so shall you haue 1080, or 10800 parts, which will bring you to the Latitude of 85 degrees and something more. But if you would make your Chart to any greater Latitude, you shall continue forth the foresaid perpendicular, and diuide it into so manie more of the same partes as you shall find needfull to attaine to the Latitude you desire. Then note euerie fift and tenth part with black leade, and set figures at them, beginning at the æquinoctial, and from thence proceeding Northwards and Southwardes.

The vse of the two first columnes of the table of Latitudes.

Then looke what numbers in the second columne are answerable to each degree, or minute in the first columne of this table of Latitudes (omitting alwaies foure or fiue of the first figures towardes the right hand) and at the same numbers of parts in the perpendiculars, make prickes on either side the æquinoctial: by which (prickes) draw right lines equidistant from the æquinoctial, for they shall be the parallels of the true nautical Planisphære, or Sea-chart.

Notwithstanding these parallels are all of them a little further distant from the æqninoctial then in trueth they should bee: and so much the more, the further they are from the æquinoctial. Which error might be something the lesse, if the former Table had been first made to smaller partes then minutes. But that were a matter more curious then necessarie, the table here before set downe being so neere the trueth, that it is not possible by any rules

or

or instruments of Nauigation, to discouer any sensible error in the Sea-chart, so farre foorth as it shall be made according thereto.

Example of the graduating of a meridian in the generall sea-chart.

The figure following containeth onely one part of the nauticall Planisphære, from the æquinoctiall Northwards, because the other part from the æquinoctiall Southwards must be altogether like and equall to this. Herein first I drew the æquinoctiall line A C, and diuided it into 36 equall parts, whereof euery one is vnderstood to conteine ten degrees, and I raised perpendiculars from euery one of those parts; which are the meridians of the Nauticall Planisphære, euery where æquidistãt each from other. Then I tooke halfe the length of the æquinoctiall with the compasses, and setting one foote in the end of the æquinoctial at C, with the other foot I made a pricke at D in the perpendicular or meridian C D. The space contained betwixt C and D, I diuided into 1080 parts, (vnderstanding euery one of the smaller parts, or segments of the line C D to conteine ten lesser parts) in such sort as before hath been shewed, and set figures to them, as here you see, for the readier numbring & finding out of any of those parts. Then I looked in the former table what number of equall parts of the meridian answered to euerie tenth degree, and (casting away fiue of the first figures next the right hand (because I conceiue the space betwixt C and D to be diuided only into 1080 parts) I found out the parts answerable to the numbers remaining in the line C D: and at those parts I made prickes, by which I drew the parallels.

As for example: in the table, the number answerable to ten degrees, is 60, casting away the fiue first figures towards the right hand: therefore I looke 60 in the line C D, and by that part I draw the parallel of ten degrees distance from the equinoctiall. Likewise the number answering to twentie degrees (omitting the fiue first figures) is 122: therefore by that number of equall parts I draw the parallel of twentie degrees latitude from the equinoctiall, &c. And after this manner I drew all the rest, as you may see in the former draught.

Chap. IIII.

Another way for graduating the meridian of a generall Sea-chart.

Therwise for the diuiding of the meridian of a general Sea-chart into his degrees, and other smaller parts of latitude, when the Chart hath not so great latitude or breadth frō the equinoctiall towards the North or South, as hath the figure before set downe; you may go thus to work: First finde out what proportion the whole longitude (or length of the Chart from West to East) must haue to the whole breadth thereof betwixt the parallels of the most Northerly and Southerly places, that are to be set downe therein: which may be done after this manner: Out of the second columne of the table of Latitudes, take the numbers of equall

equall parts of the meridian answerable to the greatest North and South latitudes that are to bee set downe in the Chart: diuide those numbers by 600,000 (that is the number of equall parts of the meridian answerable to one degree of the equinoctiall) the quotients will shew how many degrees of the equinoctiall the breadth of the Chart must be on either side the equinoctiall toward the North and South. As for example, in the generall Sea-chart to be adioyned to this booke, the latitude of the North part of the New land, found by the Hollanders about the yeere 1596, and by them called *Gebroocken land* (lying Northwards from *Norway*) is about 80 degrees. And the latitude of Queene *Elizabeths* Iland (first found by Sir *Francis Drake*, lying to the Southwards of Magellanes streights) is about 53 degrees. The numbers of equall parts of the meridian answerable to these latitudes, found out in the foresaid *Table of Latitudes* are 83,773,416, and 37,639,370; which being diuided by 600,000, the quotients are 140 and 63 almost, shewing ỹ breadth of the Chart from the equinoctiall Northwards and Southwards, in such parts whereof the equinoctiall conteineth 360; which added together shal shew that the whole breadth of the Chart from North to South must be about 203 such parts.

Hauing therefore diuided the length of the equinoctiall or any other parallel of the Chart (because they are all equall) into 360 parts, take with a paire of compasses 210 of the same parts (because that is the next greater number apt for diuision) & so keeping them vnaltered, set both feete in the meridian

at one of the ends, or in the middeſt of the Chart, and diuide the ſpace conteined betweene them firſt into ſeuen parts, and euery one of them into three, ſo haue you 21 in all: then diuide each of theſe into two, and theſe againe into fiue; ſo ſhall you haue in all 210, the number of the parts required. Now beginning at the Southermoſt of theſe parts, tell on Northwards, till you come to 66, and thereby draw the æquinoctial ouerthwart the meridian at right angles. After this you may diuide the ſaid parts of the meridian euery one into ſix, drawing foorth euerie fifth or tenth, a little further then the reſt, and ſetting figures to euery hundreth part, for the readier finding out of any number of thoſe parts that ſhall bee required. This being done, the meridian may be diuided into his degrees of latitude, and the parallels drawne after the ſame manner that wee haue alreadie ſhewed for the drawing of the former figure of a generall Sea-chart, in the Chapter next going before.

Chap. V.

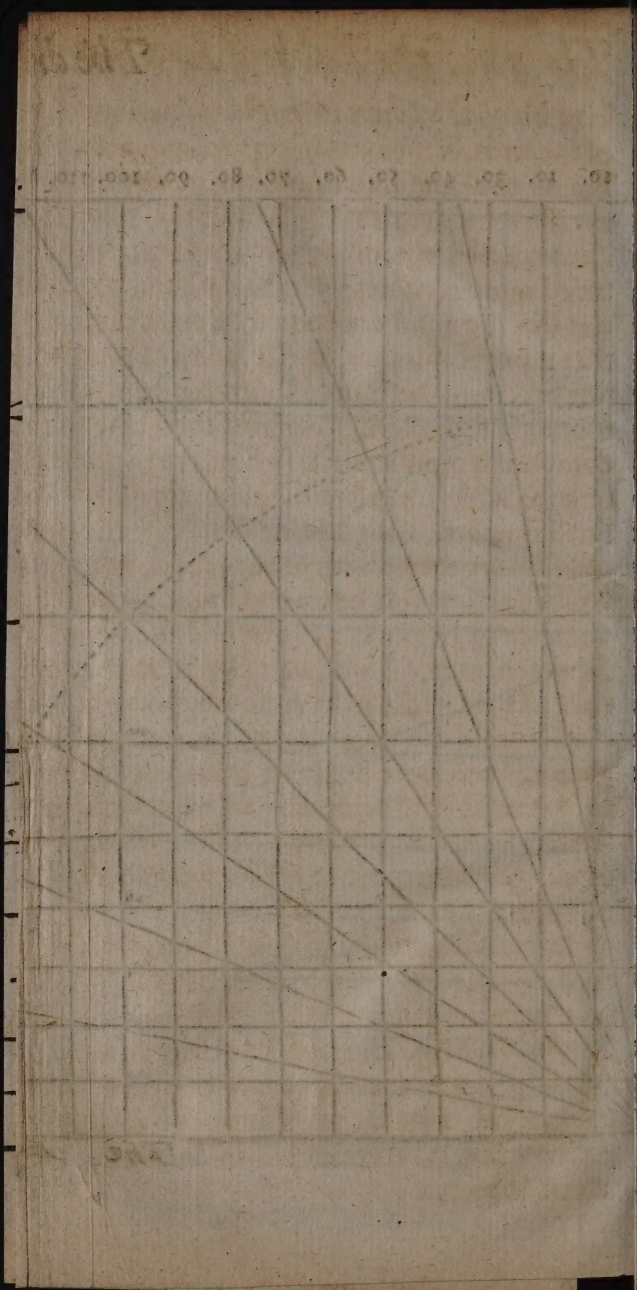
The vſe of the table of Latitudes for the true graduating of a particular Sea-chart.

TO make a particular Sea-chart, firſt conſider at what latitudes your Chart muſt begin and end: Then looke in the former table of Latitudes what numbers of equall parts are anſwerable to both thoſe latitudes, and ſubtract the equall parts anſwering to the leſſer latitude, out of ỹ equal parts anſwerable to the greater latitude; and drawing a line ouerthwart the

breadth

The draught of the Meridians, Parallels, and Rumbes of the nautical Planisphære truly made.

Place this betweene H and I, pag. 115.



breadth of the Chart from North to South (at one of the ends, or in some other vacant place thereof) diuide the same line into so many equall parts, as the difference remaining shall amount vnto: if that difference bee a compound number that may be diuided into his vnities by small diuisors. But if it fall out that the number of equal parts remaining be either a prime number, or else such a number as cannot otherwise be diuided into his vnities, but by some great diuisors, you may then take the next compound number that is greater then the said difference, which may bee diuided into his vnities by small diuisors. Thus hauing diuided ŷ line drawne ouerthwart the breadth of the Chart, into so many equall parts, as this compound number containeth vnities, and beginning at that end thereof which is supposed to bee Southwards, or next the equinoctiall, set thereto the next number of whole hundreths, or thousands, lesse then the number of equal parts answerable to the lesser latitude, and drawing foorth euery fifth, or tenth part, a little further then the rest, set figures to euery tenth, hundreth, or thousandth part, that you may readily number and find out any of them.

Then looke in the table of Latitudes which of these equall parts answere to each degree or half degree, or each tenth minute of latitude (if your Chart be of a very large prick) and with the point of your penne or compasses make marks there, and so finish the graduation of the meridian of your Chart after the accustomed manner before shewed in the former Chapter.

Example. As for example: in the particular Chart for the Azores hereunto adioyned, the least latitude is 36 degrees 10 minutes; the greatest 52 degrees 20 minutes; the equall parts answerable to these in the table of Latitudes, (casting away the foure first figures towards the right hand) are 2330 for the first, and 3698 for the second latitude. The difference of these is 1368. Then at the West end of the Chart I draw the line A B something longer then ŷ breadth of the Chart which I purpose to make, and diuide it into 1400 parts, supposing euery one of those smallest parts to stand for two. And this I doe by diuiding the whole line first into two parts, and each of these againe into seuen; so haue you 14 parts in all, whereof euery one must bee vnderstood to be diuided into 100 equall parts after the ordinarie maner, first diuiding each of them into two parts, then euery one of those into fiue, and these againe euery one into fiue parts, &c.

Now because the least latitude in this Chart beginneth at 2330 equall parts, I do therefore account the beginning of the line A B at A to be at 2300, and so proceed setting down numbers at euery 100 part, as in that Chart you may see.

Now for graduating the meridian that is adioyning, or rather all one with the line A B, you may proceed in like sort, as before was shewed, for the making of a generall Sea-chart in the third chapter: looking what number of equall parts answer to each degree in the table of Latitudes; and at the same number of equall parts in the Chart, making marks signifying those degrees, &c. As for example: In the

the table I finde answerable to 37 degr. 0 min. 2393, (casting away the three first figures next the right hand) therefore at the same number of equall parts in the line A B in the Chart, I draw forth the line of 37 degrees latitude. In like manner, at 2468 equall parts in the Chart I set downe 38 degrees, because in the table of Latitudes I finde that number answerable to 38 degrees: And at 2545 I set 39 degrees. And so forth for all the rest.

In like sort you may out of the table of Latitudes set downe euery tenth or fifth minute into this Chart; or else (which is also something easier, and not altogether so tedious) you may with a paire of compasses diuide each degree in the Chart into 12 equall parts. In which diuision, although indeede there will be some error; yet in this particular chart, or others not much exceeding this in the greatnesse either of the latitude, or of the degrees thereof, that error will bee so small, as that by sense it can either not at all, or very hardly be discerned.

Chap. VI.

The breadth of a particular Chart being giuen, to diuide the same into the degrees and minutes conteined in the difference of the least and greatest latitudes therein to be expressed.

BVt if you would make your Chart to a certeine breadth limited, which you also desire to diuide vnequally in due proportion (as hath been shewed) into the number of degrees and minutes conteined between the least and greatest

teſt latitudes which you would haue therein ſet downe: you may then goe thus to worke: Draw a line equall to the breadth of the Chart (as for example, the line C D at the Eaſt end of ỹ particular Chart for the Azores) from the South end hereof draw another line ſomething longer, making an angle therewith of ſome 20 or 30 degrees, or thereabouts, as the line C E: And hauing found out (as before in the former chapter) the number of equall parts anſwerable to the difference of the leaſt and greateſt latitudes, (as the number of 1368) diuide this line C E into ſome compound number of parts that may bee diuided by ſmall diuiſors; (that compound number exceeding the number of thoſe equall parts ſo little as conueniently may be) as into 1400. In this line, beginning from the angle at C, tell out the ſaid number of equall parts 1368, from thence draw the baſe of that angle to the end of the firſt line (as the line F D:) for parallels to this baſe, drawne by the diuiſions of the ſecond line C E, ſhal diuide the firſt line C D (that meaſureth the breadth of the Chart) into the number of equall parts anſwerable to the difference of the leaſt and greateſt latitude in the Chart. But becauſe the drawing of ſo many parallels would not onely be troubleſome and tedious, but may alſo ſomething deface the Chart; it will be better to draw parallels by ſome few principall compound numbers of parts in the ſecond line, as by euery 100 or 1000 & to ſubdiuide with the cõpaſſes the ſegments of the firſt line conteined between thoſe parallels, as in this particular Chart you may ſee. Thus hauing diuided ỹ breadth

of

of the Chart into the number of parts required, and beginning at C the South end thereof to tell 2330, (which is the number of equall parts answerable to the least latitude purposed to bee set downe in the Chart) tell on Northwards till you come to make vp an euen hundreth (as till you come to 2400) and there begin to set figures, shewing the number of the parts; and so proceed, setting figures to euerie hundreth part, and finishing the graduation of the meridian or diuision thereof into his vnequall parts in due proportion, as before you were directed in the former chapter.

Chap. VII.

The vse of the third columne of the table of Latitudes.

THe third columne being nothing else but the table of Secants, in such parts whereof the whole sine or semidiameter of the circle is supposed to conteine 10,000, may serue for all such purposes for which the table of Secants may bee vsed. Moreouer, as it serued for the making of the second columne of the table of Latitudes, as before is shewed in the second chapter, page 17 and 18, so may it be of needfull vse for the more easie examination and correction thereof, if any error hath been committed therein. First vse. Second vse.

Hereby also may bee knowne very exactly the proportion of any parallel to the equinoctiall. For what proportion the difference answerable to any degree and minute in this table hath to 10,000, the same Third vse.

same proportion hath the equinoctiall to the parallel answering to that degree and minute: (The difference answerable to any degree and minute is that which is placed next aboue the line of the same minute:) And consequently, because the like parts of circles are proportional to their wholes, you may hereby very easily and truly finde out how many leagues any arch of any parallel conteineth: for as the difference answerable to the latitude of the parallel is to 10,000, so are the minutes conteined in that arch to the miles thereof; which diuided by 3, giue the leagues.

As for example, if you would know how many leagues make a degree in the parallel of *London*, whose latitude is 51 degrees 32 minutes: as 16,075 the difference answering to that latitude page 74 is to 10,000, so is 20 (the number of leagues conteined in one degree of the equinoctiall) to 12 $\frac{284}{643}$ the number of leagues making one degree in the parallel of *London*. Thus the difference of longitude in any parallel being giuen in degrees, may easily be reduced into leagues, multiplying the same by the leagues conteined in one degree. But it may be done easlier by multiplying the difference of longitude (reduced into minutes) by 10,000, and diuiding the product by the difference of equall parts (in the table of latitudes) answerable to the latitude of the parallel wherein that difference of longitude is taken; for then the quotient sheweth the miles in the difference of longitude, which being diuided by 3, you haue the leagues.

An easie way to reduce the difference of longitude into leagues.

As for example: admit the difference of longitude

tude betweene the *Lizard* and *Fayal* be 22 degrees 52 minutes, that is 1372 minutes, which multiplied by 10,000, make 13,720,000: and this diuided by 12,898 (which is the difference of the equall parts answerable to 39 degrees 10 minutes, the lat. of the Northeast corner of *Fayal* Iland) shall giue you 1064 miles almost, that is 354 $\frac{2}{3}$ leagues, the difference of their longitudes counted in the parallel of *Fayal*.

Moreouer, by the differences set downe in the third columne may easily be found the sine of any arch of the quadrant: For as the difference answerable to any arch, or number of degrees and minutes in this table is to 10,000; so is 10,000 to the sine of the same arch. Fourth vse.

The demonstration hereof may easily be conceiued out of the Diagramme set down in the second chapter, pag. 16, wherein *ik* to *fk*, and *ak* to *gk*, that is *ae*, haue all one and the same proportion; and therefore it shall here be needlesse any further to insist hereupon.

Chap. VIII.

How to describe the Rumbes mechanically in any Sea-chart, Globe, or Mappe of what forme soeuer.

NOw becausse the nauticall planisphære (as before hath been shewed) is nothing else but a plaine parallelogramme superficies, made by extension of a sphæricall superficies inscribed into a concaue cylinder, wherein the rumbes make equall angles with euery meridian: therefore in this nauticall planisphære, if a circle be drawne

drawne and diuided into 32 equall parts, beginning at the meridian passing by the centre, of that circle: right lines drawne from the centre by those diuisions shall be the rumbes or lines which the ship describeth in sailing vpon those points, because they make equall angles with euery meridian of the nautical planisphere, those meridiãs being euery where equidistant one from another. Example hereof you haue in the former figure, and in the charts adioyned hereunto.

By helpe of this planisphere with the meridians, rumbes, and parallels thus described therein, the rumbes may much more easily and truly be drawne in the globe, then by those mechanical waies which *Petrus Nonius* teacheth, *cap. 26. lib. 2. de obser. Reg. & Instr. Geom.* Hereby also they may with no lesse facilitie be inscribed into any other Chart or mappe of what forme or proiection soeuer, if it be first diuided by meridians and parallels into degrees of longitude and latitude: For by what points of longitude and latitude in this planisphære the rumbes are described, by the same points must they be drawne in the globe, or in any other Chart or mappe whatsoeuer. Notwithstanding this may much more exactly be performed by the table of Rumbes following, which I haue made for that purpose, shewing for euerie degree of longitude, by what degree, minute ~~and second~~ of latitude euerie rumbe is to bee drawne till you come within a minute of the pole.

CHAP.

Chap. IX.

The vse of the table of Latitudes for making the table of Rumbs.

THis table of Rumbes is most easily made by addition only with help of the former table of Latitudes, after this manner: Multiplie the *Tangent* of the angle that ŷ rumbe maketh with the æquinoctiall by 60 (because euery degree of the æquinoctiall in that table is vnderstood to containe 60 times 10000 parts, each min. conteining (by supposition) 10000 parts:) the product shall be the first number at the beginning of the table of each rumbe, to be set ouer against one degree of longitude, and all the rest are found by perpetuall addition of this number, first to it selfe (for the summe is the number answerable to two degrees of longitude) then to this summe, (the product is the number that answereth to three degrees of longitude) and so forth in all the rest. These numbers being found out in the table of Latitudes, did shew at what point of latitude each rumb should crosse the meridian for euery degree of longitude, till you come within a minute of the pole. But these numbers were not thought needfull to be set down in the table following, because they serue onely for finding out the latitudes, by which the rumbes must be drawne at euery degree of longitude; which latitudes being once found, these numbers serue to no further vse.

Take

Take for example the first rumbe from the æquinoctiall, making an angle therewith of 11 degrees 15 min. the tangent whereof 1,989,122 (the whole sine being 10000000) multiplied by 60, maketh 119,347,320: but cutting off the three first figures, and seeking out the rest in the table of Latitudes, you shall finde answerable thereto 12 min. the latitude of that rumbe at one degree of longitude. Also the same number doubled (that is 238,694) and found out in the same table, shall giue you 24 min. almost, the latitude of the same rumbe for two degrees of longitude: and so forth in the rest.

To finde presently the latitude of any rumbe for any longitude.

Hereby it may appeare that the latitude of any rumbe, whatsoeuer angle it make with the æquinoctiall, may presently be found for any longitude you shall desire, if you doe but multiplie the number answering to one degree of longitude (found as before) by the longitude giuen, and finde out the product in the second columne of the foresaid table of Latitudes: for the number of degrees, minutes, &c. answering thereto in the first columne of that table shall be the latitude desired.

As for example, suppose a rumbe that maketh an angle of 5 degrees with the æquinoctial, I would know what latitude this rumbe must haue at 360 degrees of longitude: the tangent of fiue degrees is 874,887, which multiplied by 60, make 52,493,220, and this againe by 360 maketh 18,897,559,200; but cutting off the three first figures, the rest found in the foresaid table shall giue vs 30 degrees, 1 minute, the latitude of that rumbe at 360 degrees of longitude.

The first Rumbe from the meridian. } *North and by East, North and by West.* *South and by East, South and by West.*

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg.	Deg. Mi	Deg.	Deg. M.	Deg.	Deg. m. Sec.	Deg.	Deg. m. Sec.
1	5 1	31	82 27	61	89 27 2	91	89 57 10
2	10 0	32	83 5	62	89 29 46	92	89 57 22
3	14 55	33	83 40	63	89 32 15	93	89 57 33
4	19 43	34	84 12	64	89 34 33	94	89 57 43
5	24 22	35	84 40	65	89 36 39	95	89 57 53
6	28 52	36	85 8	66	89 38 33	96	89 58 2
7	33 10	37	85 32	67	89 40 19	97	89 58 9
8	37 16	38	85 55	68	89 41 56	98	89 58 15
9	41 10	39	86 15	69	89 43 24	99	89 58 21
10	44 50	40	86 34	70	89 44 45	100	89 58 27
11	48 18	41	86 51	71	89 46 0	101	89 58 33
12	51 32	42	87 8	72	89 47 8	102	89 58 38
13	54 33	43	87 22	73	89 48 10	103	89 58 43
14	57 22	44	87 35	74	89 49 7	104	89 58 47
15	59 58	45	87 47	75	89 49 57	105	89 58 51
16	62 24	46	87 58	76	89 50 47	106	89 58 55
17	64 38	47	88 9	77	89 51 31	107	89 58 59
18	66 42	48	88 18	78	89 52 11	108	89 59 3
19	68 37	49	88 26	79	89 52 38	109	89 59 6
20	70 22	50	88 34	80	89 53 5	110	89 59 9
21	72 0	51	88 41	81	89 53 43	111	89 59 12
22	73 29	52	88 48	82	89 54 20	112	89 59 15
23	74 51	53	88 54	83	89 54 46	113	89 59 18
24	76 7	54	88 59	84	89 55 11	114	89 59 20
25	77 16	55	89 5	85	89 55 30	115	89 59 22
26	78 20	56	89 9	86	89 55 53	116	89 59 24
27	79 18	57	89 13	87	89 56 11	117	89 59 26
28	80 12	58	89 17	88	89 56 28	118	89 59 28
29	81 1	59	89 21	89	89 56 44	119	89 59 30
30	81 46	60	89 24	90	89 56 58	120	89 59 32

The second Rumbe from the Meridian. } *North Northeast, North Northwest: South Southeast, South Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min	Deg.	Deg.	min.
1	2	25	31	59	41	61	81	15	92	87	37
2	4	49	32	60	53	62	81	36	94	87	49
3	7	14	33	62	2	63	81	57	96	87	59
4	9	37	34	63	9	64	82	17	98	88	9
5	11	59	35	64	13	65	82	36	100	88	18
6	14	20	36	65	15	66	82	54	102	88	26
7	16	40	37	66	14	67	83	12	104	88	34
8	18	58	38	67	12	68	83	28	106	88	41
9	21	14	39	68	7	69	83	44	108	88	47
10	23	27	40	69	0	70	84	0	110	88	53
11	25	39	41	69	50	71	84	15	112	88	58
12	27	49	42	70	39	72	84	29	114	89	3
13	29	55	43	71	26	73	84	42	116	89	8
14	32	0	44	72	12	74	84	56	118	89	12
15	34	1	45	72	55	75	85	8	120	89	16
16	36	0	46	73	37	76	85	20	122	89	19
17	37	55	47	74	17	77	85	32	124	89	23
18	39	48	48	74	55	78	85	43	126	89	26
19	41	38	49	75	32	79	85	53	128	89	28
20	43	25	50	76	8	80	86	3	130	89	31
21	45	8	51	76	42	81	86	13	134	89	35
22	46	49	52	77	14	82	86	22	138	89	39
23	48	27	53	77	46	83	86	31	142	89	42
24	50	1	54	78	16	84	86	40	146	89	45
25	51	33	55	78	44	85	86	48	150	89	47
26	53	1	56	79	12	86	86	57	158	89	51
27	54	27	57	79	39	87	87	4	166	89	53
28	55	50	58	80	4	88	87	11	178	89	56
29	57	10	59	80	29	89	87	18	201	89	58
30	58	27	60	80	52	90	87	25	225	89	59

The third Rumbe from the meridian. } *Northeast by North, Northwest by North. Southeast by South, Southwest by South.*

Lon.	Latitude.		Lon	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	1	30	31	42	1	61	67	1	91	79	23
2	3	0	32	43	8	62	67	36	92	79	40
3	4	29	33	44	12	63	68	10	93	79	55
4	5	59	34	45	16	64	68	43	94	80	11
5	7	28	35	46	19	65	69	15	95	80	26
6	8	57	36	47	20	66	69	46	96	80	41
7	10	25	37	48	21	67	70	17	97	80	55
8	11	53	38	49	20	68	70	47	98	81	9
9	13	21	39	50	18	69	71	16	99	81	23
10	14	48	40	51	14	70	71	44	100	81	36
11	16	14	41	52	10	71	72	12	101	81	49
12	17	40	42	53	5	72	72	39	102	82	2
13	19	6	43	53	58	73	73	6	103	82	14
14	20	30	44	54	50	74	73	32	104	82	26
15	21	54	45	55	41	75	73	57	105	82	37
16	23	17	46	56	31	76	74	21	106	82	49
17	24	39	47	57	20	77	74	45	107	83	0
18	26	0	48	58	8	78	75	8	108	83	11
19	27	20	49	58	55	79	75	31	109	83	21
20	28	39	50	59	41	80	75	53	110	83	31
21	29	58	51	60	26	81	76	15	111	83	41
22	31	15	52	61	10	82	76	36	112	83	51
23	32	31	53	61	52	83	76	56	113	84	1
24	33	46	54	62	34	84	77	16	114	84	10
25	35	0	55	63	15	85	77	36	115	84	19
26	36	13	56	63	55	86	77	55	116	84	28
27	37	25	57	64	34	87	78	14	117	84	36
28	38	36	58	65	12	88	78	32	118	84	44
29	39	46	59	65	49	89	78	49	119	84	53
30	40	54	60	66	26	90	79	6	120	85	1

The third rumbe from the meridian. } *Northeast & by North, Northwest by North. Southeast & by South, Southwest & by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
121	85	8	151	87	47	181	88	59	212	89	33
122	85	16	152	87	50	182	89	0	214	89	34
123	85	23	153	87	54	183	89	2	216	89	35
124	85	30	154	87	57	184	89	3	218	89	36
125	85	37	155	88	0	185	89	5	220	89	38
126	85	43	156	88	3	186	89	6	222	89	39
127	85	50	157	88	6	187	89	8	224	89	40
128	85	57	158	88	9	188	89	9	226	89	41
129	86	3	159	88	12	189	89	10	228	89	42
130	86	9	160	88	15	190	89	12	230	89	43
131	86	15	161	88	17	191	89	13	234	89	44
132	86	21	162	88	20	192	89	14	238	89	46
133	86	27	163	88	22	193	89	15	242	89	47
134	86	32	164	88	25	194	89	16	246	89	48
135	86	37	165	88	27	195	89	17	250	89	49
136	86	43	166	88	30	196	89	19	254	89	50
137	86	48	167	88	32	197	89	20	258	89	51
138	86	52	168	88	34	198	89	21	262	89	52
139	86	58	169	88	37	199	89	22	266	89	53
140	87	3	170	88	39	200	89	23	270	89	54
141	87	7	171	88	41	201	89	24	276	89	54
142	87	12	172	88	43	202	89	24	282	89	55
143	87	16	173	88	45	203	89	25	288	89	56
144	87	20	174	88	47	204	89	26	294	89	56
145	87	24	175	88	49	205	89	27	300	89	57
146	87	28	176	88	50	206	89	28	312	89	58
147	87	32	177	88	52	207	89	29	324	89	58
148	87	36	178	88	54	208	89	30	336	89	58
149	87	40	179	88	56	209	89	30	348	89	59
150	87	43	180	88	57	210	89	31	360	89	59

The fourth rumbe from the meridian. } Northeast, Northwest. Southeast, Southwest.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	1	0	31	29	35	61	51	57	91	66	54
2	2	0	32	30	28	62	52	33	92	67	18
3	3	0	33	31	19	63	53	10	93	67	41
4	4	0	34	32	10	64	53	45	94	68	3
5	5	0	35	33	0	65	54	21	95	68	25
6	5	59	36	33	50	66	54	55	96	68	47
7	6	59	37	34	40	67	55	30	97	69	9
8	7	58	38	35	29	68	56	3	98	69	30
9	8	58	39	36	18	69	56	37	99	69	51
10	9	57	40	37	6	70	57	9	100	70	11
11	10	56	41	37	53	71	57	42	101	70	31
12	11	55	42	38	41	72	58	13	102	70	51
13	12	53	43	39	27	73	58	45	103	71	11
14	13	52	44	40	13	74	59	16	104	71	30
15	14	50	45	40	59	75	59	46	105	71	49
16	15	48	46	41	44	76	60	16	106	72	7
17	16	45	47	42	28	77	60	46	107	72	26
18	17	43	48	43	12	78	61	15	108	72	44
19	18	40	49	43	56	79	61	43	109	73	1
20	19	36	50	44	39	80	62	12	110	73	19
21	20	33	51	45	21	81	62	39	111	73	36
22	21	29	52	46	3	82	63	7	112	73	53
23	22	24	53	46	44	83	63	34	113	74	9
24	23	20	54	47	25	84	64	0	114	74	25
25	24	15	55	48	6	85	64	26	115	74	41
26	25	9	56	48	45	86	64	52	116	74	57
27	26	3	57	49	25	87	65	17	117	75	12
28	26	57	58	50	3	88	65	42	118	75	28
29	27	51	59	50	42	89	66	6	119	75	43
30	28	43	60	51	19	90	66	31	120	75	57

The fourth rumbe from the meridian { *Northeast, Northwest.* / *Southeast, Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
121	76	12	151	81	48	181	85	8	211	87	7
122	76	26	152	81	56	182	85	13	212	87	10
123	76	40	153	82	4	183	85	18	213	87	13
124	76	54	154	82	13	184	85	23	214	87	16
125	77	7	155	82	21	185	85	27	215	87	19
126	77	20	156	82	29	186	85	32	216	87	22
127	77	33	157	82	36	187	85	37	217	87	24
128	77	46	158	82	44	188	85	41	218	87	27
129	77	59	159	82	51	189	85	46	219	87	30
130	78	11	160	82	59	190	85	50	220	87	32
131	78	23	161	83	6	191	85	54	221	87	35
132	78	35	162	83	13	192	85	59	222	87	37
133	78	47	163	83	20	193	86	3	223	87	40
134	78	59	164	83	27	194	86	7	224	87	42
135	79	10	165	83	34	195	86	11	225	87	44
136	79	21	166	83	41	196	86	15	226	87	47
137	79	32	167	83	47	197	86	19	227	87	49
138	79	43	168	83	54	198	86	23	228	87	51
139	79	53	169	84	0	199	86	26	229	87	54
140	80	4	170	84	6	200	86	30	230	87	56
141	80	14	171	84	12	201	86	34	231	87	58
142	80	24	172	84	18	202	86	37	232	88	0
143	80	34	173	84	24	203	86	41	233	88	2
144	80	44	174	84	30	204	86	44	234	88	4
145	80	53	175	84	36	205	86	48	235	88	6
146	81	3	176	84	41	206	86	51	236	88	8
147	81	12	177	84	47	207	86	55	237	88	10
148	81	21	178	84	52	208	86	58	238	88	12
149	81	30	179	84	57	209	87	1	239	88	14
150	81	39	180	85	3	210	87	4	240	88	16

The fourth rumbe from the meridian. } Northeast, Northwest. Southeast, Southwest.

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.
241	88 17	271	88 59	302	89 24	6	89 48
242	88 19	272	89 0	304	89 25	12	89 49
243	88 21	273	89 1	306	89 27	18	89 50
244	88 23	274	89 2	308	89 28	24	89 51
245	88 24	275	89 3	310	89 29	30	89 52
246	88 26	276	89 4	312	89 30	36	89 53
247	88 28	277	89 5	314	89 31	42	89 53
248	88 29	278	89 6	316	89 32	48	89 54
249	88 31	279	89 7	318	89 33	54	89 55
250	88 32	280	89 8	320	89 34	60	89 55
251	88 34	281	89 9	322	89 35	66	89 55
252	88 35	282	89 10	324	89 36	72	89 56
253	88 37	283	89 10	326	89 36	78	89 56
254	88 38	284	89 11	328	89 37	84	89 57
255	88 39	285	89 12	330	89 38	90	89 57
256	88 41	286	89 13	332	89 39	96	89 57
257	88 42	287	89 14	334	89 39	102	89 57
258	88 44	288	89 15	336	89 40	108	89 58
259	88 45	289	89 15	338	89 41	114	89 58
260	88 46	290	89 16	340	89 41	120	89 58
261	88 47	291	89 17	342	89 42	126	89 58
262	88 49	292	89 18	344	89 43	132	89 58
263	88 50	293	89 18	346	89 43	138	89 58
264	88 51	294	89 19	348	89 44	144	89 58
265	88 52	295	89 20	350	89 44	150	89 59
266	88 53	296	89 20	352	89 45	156	89 59
267	88 55	297	89 21	354	89 45	162	89 59
268	88 56	298	89 22	356	89 46	168	89 59
269	88 57	299	89 22	358	89 46	174	89 59
270	88 58	300	89 23	360	89 47	180	89 59

The fifth Rumbe from the meridian. } *Northeast & by East, Southeast and by East: Northwest & by West, Southwest and by West.*

Lon.	Latitude.		Lon	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	0	40	31	20	17	61	37	42	91	51	49
2	1	20	32	20	54	62	38	14	92	52	14
3	2	0	33	21	31	63	38	45	93	52	39
4	2	40	34	22	9	64	39	16	94	53	3
5	3	20	35	22	46	65	39	47	95	53	27
6	4	0	36	23	23	66	40	18	96	53	50
7	4	40	37	23	59	67	40	48	97	54	14
8	5	20	38	24	36	68	41	18	98	54	37
9	6	0	39	25	12	69	41	48	99	55	0
10	6	40	40	25	48	70	42	18	100	55	23
11	7	20	41	26	24	71	42	48	101	55	46
12	8	0	42	27	0	72	43	17	102	56	8
13	8	39	43	27	36	73	43	46	103	56	31
14	9	19	44	28	11	74	44	14	104	56	53
15	9	58	45	28	47	75	44	44	105	57	14
16	10	38	46	29	22	76	45	12	106	57	36
17	11	17	47	29	56	77	45	40	107	57	57
18	11	56	48	30	31	78	46	8	108	58	19
19	12	36	49	31	5	79	46	36	109	58	40
20	13	15	50	31	40	80	47	3	110	59	0
21	13	54	51	32	14	81	47	30	111	59	20
22	14	32	52	32	48	82	47	57	112	59	41
23	15	11	53	33	21	83	48	24	113	60	1
24	15	50	54	33	55	84	48	50	114	60	21
25	16	28	55	34	28	85	49	17	115	60	41
26	17	7	56	35	1	86	49	43	116	61	0
27	17	45	57	35	33	87	50	9	117	61	20
28	18	33	58	36	5	88	50	34	118	61	39
29	19	1	59	36	38	89	50	59	119	61	58
30	19	39	60	37	10	90	51	25	120	62	17

The fifth Rumbe from the meridian. { *Northeast and by East, Southeast and by East: Northwest and by West, Southwest and by West.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg.	Deg.	Mi.
121	62	35	151	70	29	181	76	11	211	80	14
122	62	53	152	70	43	182	76	20	212	80	21
123	63	12	153	70	56	183	76	30	213	80	27
124	63	30	154	71	9	184	76	39	214	80	34
125	63	47	155	71	22	185	76	48	215	80	41
126	64	6	156	71	35	186	76	57	216	80	47
127	64	22	157	71	47	187	77	6	217	80	53
128	64	40	158	72	0	188	77	15	218	81	0
129	64	57	159	72	12	189	77	24	219	81	6
130	65	14	160	72	24	190	77	33	220	81	12
131	65	30	161	72	36	191	77	41	221	81	18
132	55	47	162	72	48	192	77	50	222	81	24
133	66	3	163	73	0	193	77	58	223	81	30
134	66	19	164	73	11	194	78	6	224	81	36
135	66	35	165	73	23	195	78	15	225	81	42
136	66	51	166	73	34	196	78	23	226	81	48
137	67	7	167	73	46	197	78	31	227	81	53
138	67	22	168	73	57	198	78	39	228	81	59
139	67	38	169	74	8	199	78	47	229	82	4
140	67	53	170	74	19	200	78	54	230	82	10
141	68	8	171	74	29	201	79	2	231	82	15
142	68	23	172	74	40	202	79	10	232	82	21
143	68	37	173	74	51	203	79	17	233	82	26
144	68	52	174	75	1	204	79	24	234	82	31
145	69	6	175	75	11	205	79	32	235	82	36
146	69	21	176	75	22	206	79	39	236	82	42
147	69	35	177	75	32	207	79	46	237	82	47
148	69	49	178	75	42	208	79	53	238	82	52
149	70	2	179	75	51	209	80	0	239	82	57
150	70	16	180	76	1	210	80	7	240	83	2

The fifth rumbe from the meridian.	Northeast and by East, Southeast and by East: Northwest and by West, Southwest and by West.

Lon.	Latitud.		Lon.	Latitude		Lon.	Latitude.		Lon	Latitude.	
Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
241	83	6	271	85	8	301	86	34	331	87	35
242	83	11	272	85	12	302	86	36	332	87	37
243	83	16	273	85	15	303	86	39	333	87	38
244	83	21	274	85	18	304	86	41	334	87	40
245	83	25	275	85	21	305	86	43	335	87	42
246	83	30	276	85	25	306	86	46	336	87	43
247	83	34	277	85	28	307	86	48	337	87	45
248	83	39	278	85	31	308	86	50	338	87	47
249	83	43	279	85	34	309	86	57	339	87	48
250	83	47	280	85	37	310	86	55	340	87	50
251	83	52	281	85	40	311	86	57	341	87	51
252	84	56	282	85	43	312	86	59	342	87	53
253	84	0	283	85	46	313	87	1	343	87	54
254	84	4	284	85	49	314	87	3	344	87	55
255	84	8	285	85	52	315	87	6	345	87	57
256	84	13	286	85	55	316	87	8	346	87	58
257	84	17	287	85	58	317	87	10	347	88	0
258	84	21	288	86	0	318	87	12	348	88	1
259	84	24	289	86	3	319	87	13	349	88	2
260	84	28	290	86	6	320	87	15	350	88	4
261	84	32	291	86	8	321	87	17	351	88	5
262	84	36	292	86	11	322	87	19	352	88	6
263	84	40	293	86	14	323	87	21	353	88	8
264	84	43	294	86	17	324	87	23	354	88	9
265	84	47	295	86	19	325	87	25	355	88	10
266	84	51	296	86	22	326	87	26	356	88	12
267	84	54	297	86	24	327	87	28	357	88	13
268	84	58	298	86	27	328	87	30	358	88	14
269	85	1	299	86	29	329	87	32	359	88	15
270	85	5	300	86	32	330	87	33	360	88	17

The fifth rumbe from the meridian.	Nurtheast and by East, Southeast and by East: Northwest and by West, Southwest and by West.							
Lon.	Latitude.	Lon.	Latitude	Lon.	Latitude.	on.	Latitude.	
Deg	Deg. Mi.	Deg	Deg. Mi.	Deg	Deg. Mi.	Deg	Deg. Mi.	
1	88 18	32	88 49	92	89 24	155	89 43	
2	88 19	34	88 50	94	89 25	160	89 44	
3	88 20	36	88 52	96	89 26	165	89 44	
4	88 21	38	88 53	98	89 27	170	89 45	
5	88 22	40	88 55	100	89 27	175	89 46	
6	88 23	42	88 56	102	89 28	180	89 47	
7	88 25	44	88 58	104	89 29	185	89 48	
8	88 26	46	88 59	106	89 30	190	89 48	
9	88 27	48	89 1	108	89 30	195	89 49	
10	88 28	50	89 2	110	89 31	200	89 49	
11	88 29	52	89 3	112	89 32	210	89 51	
12	88 30	54	89 5	114	89 32	220	89 52	
13	88 31	56	89 6	116	89 33	230	89 52	
14	88 32	58	89 7	118	89 33	240	89 53	
15	88 33	60	89 8	120	89 34	250	89 54	
16	88 34	62	89 10	122	89 35	260	89 55	
17	88 35	64	89 11	124	89 35	270	89 55	
18	88 36	66	89 12	126	89 36	280	89 56	
19	88 37	68	89 13	128	89 36	290	89 56	
20	88 38	70	89 14	130	89 37	300	89 56	
21	88 39	72	89 15	132	89 37	310	89 57	
22	88 40	74	89 16	134	89 38	320	89 57	
23	88 41	76	89 17	136	89 38	330	89 57	
24	88 42	78	89 18	138	89 39	340	89 58	
25	88 43	80	89 19	140	89 39	350	89 58	
26	88 43	82	89 20	142	89 40	360	89 58	
27	88 44	84	89 21	144	89 40	30	89 58	
28	88 45	86	89 22	146	89 41	60	89 59	
29	88 46	88	89 23	148	89 41	90	89 59	
30	88 47	90	89 23	150	89 42	120	89 59	

The sixth rumbe from the meridian. } *East Northeast, East Southeast: West Northwest, West Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
1	0	25	31	12	44	61	24	29	91	35	14
2	0	50	32	13	8	62	24	52	92	35	34
3	1	15	33	13	32	63	25	14	93	35	55
4	1	39	34	13	57	64	25	37	94	36	15
5	2	4	35	14	21	65	25	59	95	36	35
6	2	29	36	14	45	66	26	21	96	36	55
7	2	54	37	15	9	67	26	44	97	37	14
8	3	19	38	15	33	68	27	6	98	37	34
9	3	44	39	15	57	69	27	28	99	37	54
10	4	8	40	16	21	70	27	50	100	38	13
11	4	33	41	16	44	71	28	12	101	38	32
12	4	58	42	17	8	72	28	34	102	38	52
13	5	23	43	17	31	73	28	55	103	39	12
14	5	47	44	17	55	74	29	17	104	39	31
15	6	12	45	18	20	75	29	39	105	39	49
16	6	37	46	18	42	76	30	0	106	40	8
17	7	1	47	19	6	77	30	22	107	40	27
18	7	26	48	19	29	78	30	43	108	40	47
19	7	51	49	19	53	79	31	5	109	41	6
20	8	15	50	20	16	80	31	26	110	41	24
21	8	40	51	20	40	81	31	46	111	41	42
22	9	4	52	21	2	82	32	8	112	42	1
23	9	29	53	21	26	83	32	29	113	42	20
24	9	54	54	21	49	84	32	50	114	42	38
25	10	17	55	22	12	85	33	10	115	42	56
26	10	42	56	22	35	86	33	32	116	43	14
27	11	7	57	22	58	87	33	52	117	43	32
28	11	31	58	23	20	88	34	12	118	43	50
29	11	56	59	23	44	89	34	33	119	44	8
30	12	20	60	24	6	90	34	54	120	44	26

The sixth rumbe from the meridian. } *East Northeast, East Southeast: West Northwest, West Southwest.*

Lon.	Latitude.		Lon.	Latitude		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min	Deg	Deg.	min.
121	44	43	151	52	53	181	59	45	211	65	27
122	45	1	152	53	8	182	59	58	212	65	37
123	45	18	153	53	23	183	60	10	213	65	48
124	45	36	154	53	37	184	60	22	214	65	58
125	45	53	155	53	53	185	60	35	215	66	8
126	46	10	156	54	7	186	60	47	216	66	18
127	46	28	157	54	21	187	60	59	217	66	28
128	46	45	158	54	36	188	61	11	218	66	38
129	47	2	159	54	50	189	61	23	219	66	48
130	47	19	160	55	4	190	61	35	220	66	57
131	47	35	161	55	18	191	61	47	221	67	7
132	47	53	162	55	33	192	61	58	222	67	17
133	48	9	163	55	47	193	62	10	223	67	26
134	48	25	164	56	0	194	62	21	224	67	36
135	48	42	165	56	14	195	62	33	225	67	45
136	48	59	166	56	28	196	62	44	226	67	54
137	49	14	167	56	42	197	62	56	227	68	4
138	49	31	168	56	55	198	63	7	228	68	13
139	49	47	169	57	9	199	63	18	229	68	22
140	50	3	170	57	22	200	63	29	230	68	31
141	50	18	171	57	36	201	63	40	231	68	40
142	50	34	172	57	50	202	63	51	232	68	49
143	50	51	173	58	2	203	64	2	233	68	58
144	51	6	174	58	15	204	64	13	234	69	7
145	51	21	175	58	28	205	64	24	235	69	16
146	51	37	176	58	41	206	64	36	236	69	25
147	51	53	177	58	54	207	64	45	237	69	34
148	52	7	178	59	7	208	64	56	238	69	42
149	52	23	179	59	20	209	65	6	239	69	51
150	52	38	180	59	32	210	65	17	240	69	59

The sixth rumbe from the meridian. } *East Northeast, East Southeast. West Northwest, West Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
241	70	8	271	73	57	301	77	3	331	79	33
242	70	16	272	74	4	302	77	8	332	79	38
243	70	25	273	74	10	303	77	14	333	79	42
244	70	33	274	74	17	304	77	19	334	79	47
245	70	41	275	74	24	305	77	25	335	79	51
246	70	49	276	74	31	306	77	30	336	79	55
247	70	57	277	74	37	307	77	35	337	80	0
248	71	6	278	74	44	308	77	41	338	80	4
249	71	14	279	74	50	309	77	46	339	80	8
250	71	22	280	74	57	310	77	51	340	80	12
251	71	29	281	75	3	311	77	56	341	80	17
252	71	37	282	75	9	312	78	2	342	80	21
253	71	45	283	75	16	313	78	7	343	80	25
254	71	53	284	75	22	314	78	12	344	80	29
255	72	1	285	75	28	315	78	17	345	80	33
256	72	8	286	75	35	316	78	22	346	80	37
257	72	16	287	75	41	317	78	27	347	80	41
258	72	23	288	75	47	318	78	32	348	80	45
259	72	31	289	75	53	319	78	37	349	80	49
260	72	38	290	75	59	320	78	42	350	80	53
261	72	46	291	76	5	321	78	47	351	80	57
262	72	53	292	76	11	322	78	51	352	81	1
263	73	0	293	76	17	323	78	56	353	81	5
264	73	7	294	76	22	324	79	1	354	81	9
265	73	15	295	76	29	325	79	6	355	81	13
266	73	22	296	76	34	326	79	10	356	81	16
267	73	29	297	76	40	327	79	15	357	81	20
268	73	36	298	76	46	328	79	20	358	81	24
269	73	43	299	76	51	329	79	24	359	81	28
270	73	50	300	76	57	330	79	29	360	81	31

The sixth rumbe from the meridian. } *East Northeast, East Southeast: West Northwest, West Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
1	81	35	31	83	13	61	84	32	91	85	36
2	81	38	32	83	16	62	84	34	92	85	38
3	81	42	33	83	19	63	84	37	93	85	40
4	81	46	34	83	22	64	84	39	94	85	42
5	81	49	35	83	25	65	84	41	95	85	43
6	81	53	36	83	27	66	84	44	96	85	45
7	81	56	37	83	30	67	84	46	97	85	47
8	82	0	38	83	33	68	84	48	98	85	49
9	82	3	39	83	36	69	84	50	99	85	51
10	82	7	40	83	39	70	84	53	100	85	52
11	82	9	41	83	41	71	84	55	101	85	54
12	82	13	42	83	44	72	84	57	102	85	56
13	82	17	43	83	47	73	84	59	103	85	57
14	82	20	44	83	49	74	85	1	104	85	59
15	82	23	45	83	52	75	85	4	105	86	1
16	82	27	46	83	55	76	85	6	106	86	3
17	82	30	47	83	57	77	85	8	107	86	5
18	82	33	48	84	0	78	85	10	108	86	6
19	82	36	49	84	2	79	85	12	109	86	8
20	82	39	50	84	5	80	85	14	110	86	10
21	82	43	51	84	8	81	85	16	111	86	11
22	82	46	52	84	10	82	85	18	112	86	13
23	82	49	53	84	13	83	85	20	113	86	15
24	82	52	54	84	15	84	85	22	114	86	16
25	82	55	55	84	18	85	85	24	115	86	17
26	82	58	56	84	20	86	85	26	116	86	19
27	83	1	57	84	22	87	85	28	117	86	21
28	83	4	58	84	25	88	85	30	118	86	23
29	83	7	59	84	27	89	85	32	119	86	24
30	83	10	60	84	30	90	85	34	120	86	26

The sixth rumbe from the meridian. } *East Northeast, East Southeast. West Northwest; West Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
122	86	29	182	87	43	244	88	32	8	89	24
124	86	32	184	87	45	248	88	35	16	89	26
126	86	35	186	87	47	252	88	37	24	89	28
128	86	38	188	87	49	256	88	40	32	89	30
130	86	41	190	87	51	260	88	42	40	89	31
132	86	43	192	87	53	264	88	44	48	89	33
134	86	46	194	87	55	268	88	46	56	89	34
136	86	49	196	87	56	272	88	48	64	89	36
138	86	52	198	87	58	276	88	50	72	89	37
140	86	55	200	88	0	280	88	52	80	89	38
142	86	58	202	88	2	284	88	54	88	89	40
144	87	0	204	88	3	288	88	56	96	89	41
146	87	3	206	88	5	292	88	58	104	89	42
148	87	5	208	88	7	296	89	0	112	89	43
150	87	8	210	88	8	300	89	1	120	89	44
152	87	10	212	88	10	304	89	3	136	89	45
154	87	13	214	88	11	308	89	5	152	89	47
156	87	15	216	88	13	312	89	6	168	89	48
158	87	17	218	88	14	316	89	8	184	89	50
160	87	20	220	88	16	320	89	9	200	89	51
162	87	22	222	88	17	324	89	11	216	89	52
164	87	24	224	88	19	328	89	12	240	89	53
166	87	27	226	88	20	332	89	13	264	89	54
168	87	29	228	88	22	336	89	15	288	89	55
170	87	31	230	88	23	340	89	16	312	89	56
172	87	33	232	88	25	344	89	17	336	89	56
174	87	35	234	88	26	348	89	18	360	89	57
176	87	37	236	88	27	352	89	20	90	89	58
178	87	39	238	88	29	356	89	21	180	89	59
180	87	41	240	88	30	360	89	22	270	89	59

The seuenth rumbe from the meridian. { *East and by North, East and by South.* / *West and by North, West and by South.*

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg	Deg. Mi	Deg	Deg. Mi.	Deg.	Deg. Mi.	Deg	Deg. Mi.
1	0 12	31	6 9	61	12 3	91	17 48
2	0 24	32	6 21	62	12 14	92	18 0
3	0 36	33	6 33	63	12 25	93	18 11
4	0 48	34	6 45	64	12 38	94	18 22
5	1 0	35	6 57	65	12 49	95	18 34
6	1 12	36	7 9	66	13 1	96	18 44
7	1 24	37	7 20	67	13 13	97	18 56
8	1 35	38	7 32	68	13 24	98	19 8
9	1 47	39	7 44	69	13 36	99	19 20
10	1 59	40	7 56	70	13 47	100	19 30
11	2 11	41	8 8	71	13 59	101	19 41
12	2 23	42	8 19	72	14 11	102	19 53
13	2 35	43	8 32	73	14 22	103	20 4
14	2 47	44	8 43	74	14 34	104	20 15
15	2 59	45	8 54	75	14 45	105	20 26
16	3 11	46	9 7	76	14 57	106	20 37
17	3 23	47	9 18	77	15 8	107	20 49
18	3 35	48	9 30	78	15 20	108	21 0
19	3 47	49	9 42	79	15 31	109	21 11
20	3 59	50	9 53	80	15 43	110	21 22
21	4 10	51	10 6	81	15 54	111	21 33
22	4 22	52	10 17	82	16 6	112	21 44
23	4 34	53	10 29	83	16 17	113	21 55
24	4 46	54	10 40	84	16 29	114	22 6
25	4 58	55	10 53	85	16 40	115	22 17
26	5 10	56	11 4	86	16 51	116	22 28
27	5 22	57	11 16	87	17 3	117	22 39
28	5 34	58	11 28	88	17 14	118	22 50
29	5 45	59	11 39	89	17 26	119	23 1
30	5 57	60	11 51	90	17 37	120	23 12

The seuenth rumbe from the meridian. } *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min.
121	23	23	151	28	45	181	33	51	211	38	39
122	23	34	152	28	55	182	34	1	212	38	48
123	23	45	153	29	6	183	34	10	213	38	58
124	23	56	154	29	16	184	34	20	214	39	7
125	24	7	155	29	27	185	34	30	215	39	16
126	24	18	156	29	37	186	34	40	216	39	25
127	24	29	157	29	47	187	34	50	217	39	35
128	24	40	158	29	58	188	35	0	218	39	44
129	24	51	159	30	8	189	35	9	219	39	53
130	25	1	160	30	18	190	35	19	220	40	2
131	25	12	161	30	29	191	35	29	221	40	11
132	25	23	162	30	39	192	35	38	222	40	20
133	25	34	163	30	49	193	35	48	223	40	30
134	25	45	164	30	59	194	35	58	224	40	39
135	25	55	165	31	10	195	36	7	225	40	48
136	26	6	166	31	20	196	36	17	226	40	57
137	26	17	167	31	30	197	36	26	227	41	6
138	26	27	168	31	40	198	36	36	228	41	15
139	26	38	169	31	50	199	36	46	229	41	24
140	26	49	170	32	0	200	36	55	230	41	33
141	26	59	171	32	11	201	37	5	231	41	41
142	27	10	172	32	20	202	37	14	232	41	50
143	27	21	173	32	31	203	37	24	233	41	59
144	27	31	174	32	41	204	37	33	234	42	8
145	27	42	175	32	51	205	37	43	235	42	17
146	27	52	176	33	1	206	37	52	236	42	26
147	28	3	177	33	11	207	38	2	237	42	35
148	28	13	178	33	21	208	38	11	238	42	43
149	28	24	179	33	31	209	38	20	239	42	52
150	28	34	180	33	41	210	38	30	240	43	1

The seuenth rumbe from the meridian. } *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min	Deg	Deg.	min.
241	43	10	271	47	21	301	51	15	331	54	50
242	43	18	272	47	29	302	51	22	332	54	57
243	43	27	273	47	38	303	51	30	333	55	3
244	43	36	274	47	46	304	51	37	334	55	10
245	43	44	275	47	54	305	51	44	335	55	17
246	43	53	276	48	2	306	51	52	336	55	24
247	44	1	277	48	10	307	51	59	337	55	31
248	44	10	278	48	17	308	52	6	338	55	37
249	44	19	279	48	25	209	52	14	339	55	44
250	44	27	280	48	33	310	52	21	340	55	51
251	44	36	281	48	41	311	52	28	341	55	58
252	44	44	282	48	49	312	52	36	342	56	4
253	44	53	283	48	57	313	52	43	343	56	11
254	45	1	284	49	5	314	52	50	344	56	17
255	45	9	285	49	13	315	52	57	345	56	24
256	45	18	286	49	20	316	53	4	346	56	31
257	45	26	287	49	28	317	53	12	347	56	37
258	45	35	288	49	36	318	53	19	248	56	44
259	45	43	289	49	44	319	53	26	349	56	50
260	45	51	290	49	51	320	53	33	350	56	57
261	46	0	291	49	59	321	53	40	351	57	3
262	46	8	292	50	7	322	53	47	352	57	10
263	46	16	293	50	14	323	53	54	353	57	16
264	46	24	294	50	22	324	54	1	354	57	23
265	46	33	295	50	29	325	54	8	355	57	29
266	46	41	296	50	37	326	54	15	356	57	36
267	46	49	297	50	45	327	54	22	357	57	42
268	46	57	298	50	52	328	54	29	358	57	48
269	47	5	299	51	0	329	54	36	359	57	55
270	47	13	300	51	7	330	54	43	360	58	1

The seuenth rumbe from the meridian. } *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	58	7	31	61	8	61	63	53	91	66	24
2	58	14	32	61	14	62	63	58	92	66	28
3	58	20	33	61	20	63	64	4	93	66	33
4	58	26	34	61	25	64	64	9	94	66	38
5	58	32	35	61	31	65	64	14	95	66	43
6	58	39	36	61	37	66	64	19	96	66	47
7	58	45	37	61	42	67	64	24	97	66	52
8	58	51	38	61	48	68	64	30	98	66	57
9	58	57	39	61	54	69	64	35	99	67	1
10	59	3	40	61	59	70	64	40	100	67	6
11	59	9	41	62	5	71	64	45	101	67	11
12	59	16	42	62	10	72	64	50	102	67	15
13	59	22	43	62	16	73	64	55	103	67	20
14	59	28	44	62	22	74	65	0	104	67	24
15	59	34	45	62	27	75	65	5	105	67	29
16	59	40	46	62	33	76	65	10	106	67	34
17	59	46	47	62	38	77	65	15	107	67	38
18	59	52	48	62	44	78	65	20	108	67	43
19	59	58	49	62	49	79	65	25	109	67	47
20	60	4	50	62	54	80	65	30	110	67	52
21	60	10	51	63	0	81	65	35	111	67	56
22	60	16	52	63	5	82	65	40	112	68	1
23	60	22	53	63	11	83	65	45	113	68	5
24	60	27	54	63	16	84	65	50	114	68	10
25	60	33	55	63	21	85	65	55	115	68	14
26	60	39	56	63	27	86	66	0	116	68	18
27	60	45	57	63	32	87	66	4	117	68	23
28	60	51	58	63	37	88	66	9	118	68	27
29	60	57	59	63	43	89	66	14	119	68	32
30	61	2	60	63	48	90	66	19	120	68	36

The seuenth rumbe from the meridian. } *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.
121	68	40	151	70	44	181	72	37	211	74	19
122	68	45	152	70	48	182	72	40	212	74	22
123	68	49	153	70	52	183	72	44	213	74	25
124	68	53	154	70	56	184	72	47	214	74	28
125	68	58	155	71	0	185	72	51	215	74	31
126	69	2	156	71	4	186	72	54	216	74	35
127	69	6	157	71	8	187	72	58	217	74	38
128	69	10	158	71	12	188	73	1	218	74	41
129	69	15	159	71	15	189	73	5	219	74	44
130	69	19	560	71	19	190	73	8	220	74	47
131	69	23	161	71	23	191	73	12	221	74	50
132	69	27	162	71	27	192	73	15	222	74	53
133	69	31	163	71	31	193	73	18	223	74	56
134	69	36	164	71	34	194	73	22	224	75	0
135	69	40	165	71	38	195	73	25	225	75	3
136	69	44	166	71	42	196	73	29	226	75	6
137	69	48	167	71	46	197	73	32	227	75	9
138	69	52	168	71	49	198	73	36	228	75	12
139	69	56	169	71	53	199	73	39	229	75	15
140	70	0	170	71	57	200	73	42	230	75	18
141	70	4	171	72	0	201	73	46	231	75	21
142	70	8	172	72	4	202	73	49	232	75	24
143	70	12	173	72	8	203	73	52	233	75	27
144	70	16	174	72	11	204	73	56	234	75	30
145	70	20	175	72	15	205	73	59	235	75	33
146	70	24	176	72	19	206	74	2	236	75	36
147	70	28	177	72	22	207	74	6	237	75	39
148	70	32	178	72	26	208	74	9	238	75	42
149	70	36	179	72	30	209	74	12	239	75	45
150	70	40	180	72	33	210	74	15	340	75	48

The seuenth rumbe from the meridian. { *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
241	75	51	271	77	14	301	78	29	331	79	37
242	75	54	272	77	16	302	78	31	332	79	39
243	75	56	273	77	19	303	78	34	333	79	41
244	75	59	274	77	22	304	78	36	334	79	43
245	76	2	275	77	24	305	78	38	335	79	45
246	76	5	276	77	27	306	78	41	336	79	48
247	76	8	277	77	29	307	78	43	337	79	50
248	76	11	278	77	32	308	78	46	338	79	52
249	76	14	279	77	35	309	78	48	339	79	54
250	76	16	280	77	37	310	78	50	340	79	56
251	76	19	281	77	40	311	78	52	341	79	58
252	76	22	282	77	42	312	78	55	342	80	0
253	76	25	283	77	45	313	78	57	343	80	2
254	76	28	284	77	47	314	78	59	344	80	4
255	76	30	285	77	50	315	79	2	345	80	6
256	76	33	286	77	52	316	79	4	346	80	8
257	76	36	287	77	55	317	79	6	347	80	10
258	76	39	288	77	57	318	79	8	348	80	12
259	76	42	289	78	0	319	79	11	249	80	14
260	76	44	290	78	2	320	79	13	350	80	16
261	76	47	291	78	5	321	79	15	351	80	18
262	76	50	292	78	7	322	79	17	352	80	20
263	76	52	293	78	10	323	79	19	353	80	22
264	76	55	294	78	12	324	79	22	354	80	24
265	76	58	295	78	15	325	79	24	355	80	26
266	77	1	296	78	17	326	79	26	356	80	28
267	77	3	297	78	19	327	79	28	357	80	30
268	77	6	298	78	22	328	79	30	358	80	32
269	77	9	299	78	24	329	79	33	359	80	34
270	77	11	300	78	27	330	79	35	360	80	36

The seuenth rumbe from the meridian. } East and by North, East and by South: West and by North, West and by South.

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg.	Deg. min.	Deg.	Deg. min.	Deg.	Deg. min	Deg.	Deg. min.
2	80 40	62	82 25	122	83 50	183	85 1
4	80 44	64	82 28	124	83 53	186	85 4
6	80 48	66	82 31	126	83 55	189	85 7
8	80 52	68	82 34	128	83 58	192	85 10
10	80 55	70	82 37	130	84 0	195	85 13
12	80 59	72	82 40	132	84 3	198	85 16
14	81 3	74	82 43	134	84 5	201	85 19
16	81 7	76	82 47	136	84 8	204	85 20
18	81 10	78	82 49	138	84 10	207	85 24
20	81 14	80	82 52	140	84 13	210	85 27
22	81 18	82	82 55	142	84 15	213	85 30
24	81 21	84	82 58	144	84 17	216	85 33
26	81 25	86	83 1	146	84 20	219	85 36
28	81 28	88	83 4	148	84 22	222	85 38
30	81 32	90	83 7	150	84 24	225	85 41
32	81 35	92	83 10	152	84 26	228	85 44
34	81 39	94	83 13	154	84 29	231	85 46
36	81 42	96	83 15	156	84 31	234	85 49
38	81 46	98	83 18	158	84 34	237	85 52
40	81 49	100	83 21	160	84 36	240	85 54
42	81 52	102	83 24	162	84 38	243	85 57
44	81 56	104	83 27	164	84 40	246	85 59
46	81 59	106	83 29	166	84 42	249	86 2
48	82 2	108	83 32	168	84 45	252	86 4
50	82 6	110	83 35	170	84 47	255	86 7
52	82 9	112	83 37	172	84 49	258	86 9
54	82 12	114	83 40	174	84 51	261	86 11
56	82 15	116	83 43	176	84 53	264	86 14
58	82 19	118	83 45	178	84 55	267	86 16
60	82 22	120	83 48	180	84 58	270	86 18

The seuenth rumbe from the meridian. { *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg.	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.
273	86 21	3	87 20	126	88 15	12	89 15
276	86 23	6	87 22	132	88 17	24	89 17
279	86 25	9	87 23	138	88 20	36	89 19
282	86 28	12	87 25	144	88 22	48	89 20
285	86 30	15	87 26	150	88 24	60	89 22
288	86 32	18	87 28	156	88 26	72	89 24
291	86 34	21	87 30	162	88 28	84	89 25
294	86 36	24	87 31	168	88 29	98	89 27
297	86 38	27	87 33	174	88 31	114	89 28
300	86 40	30	87 34	180	88 33	130	89 30
303	86 42	33	87 36	189	88 36	146	89 32
306	86 44	36	87 37	198	88 38	162	89 33
309	86 46	39	87 39	207	88 41	178	88 35
312	86 48	42	87 40	216	88 43	194	88 36
315	86 50	45	87 42	225	88 46	210	88 37
318	86 52	48	87 43	234	88 48	240	89 39
321	86 55	51	87 44	243	88 50	270	89 41
324	86 57	54	87 46	252	88 52	300	89 43
327	86 59	57	87 47	261	88 54	330	89 45
330	87 1	60	87 49	270	88 56	360	89 46
333	87 2	66	87 51	279	88 58	36	89 48
336	87 4	72	87 54	288	89 0	72	89 49
339	87 6	78	87 56	297	89 2	108	89 50
342	87 8	84	87 59	306	89 4	144	89 51
345	87 10	90	88 1	315	89 5	180	89 52
348	87 11	96	88 4	324	89 7	240	89 54
351	87 13	102	88 6	333	89 9	360	89 56
354	87 15	108	88 9	342	89 10	180	89 57
357	87 17	114	88 11	351	89 12	360	89 58
360	87 18	120	88 13	360	89 13	180	89 59

The eighth Rumbe from the meridian { East: West.

Latitude.		1. deg. of lon.			Differ.	Latitude		1. deg. of lon.			Differ.
Deg.	Mi.	min.	sec.	thir.	sec. thir.	Deg.	Mi.	min.	sec.	thir.	sec. thir.
0	10	59	59	59	0 1	5	10	59	45	22	0 56
0	20	59	59	56	0 3	5	20	59	44	25	0 57
0	30	59	59	52	0 4	5	30	59	43	26	0 59
0	40	59	59	45	0 7	5	40	59	42	24	1 2
0	50	59	59	37	0 8	5	50	59	41	21	1 3
1	0	59	59	27	0 10	6	0	59	40	17	1 4
1	10	59	59	15	0 12	6	10	59	39	10	1 7
1	20	59	59	2	0 13	6	20	59	38	2	1 8
1	30	59	58	46	0 16	6	30	59	36	52	1 10
1	40	59	58	29	0 17	6	40	59	35	39	1 13
1	50	59	58	9	0 20	6	50	59	34	26	1 13
2	0	59	57	48	0 21	7	0	59	33	10	1 16
2	10	59	57	26	0 22	7	10	59	31	52	1 18
2	20	59	57	1	0 25	7	20	59	30	33	1 19
2	30	59	56	34	0 27	7	30	59	29	12	1 21
2	40	59	56	6	0 28	7	40	59	27	49	1 23
2	50	59	55	36	0 30	7	50	59	26	24	1 25
3	0	59	55	4	0 32	8	0	59	24	58	1 26
3	10	59	54	30	0 34	8	10	59	23	30	1 28
3	20	59	53	55	0 35	8	20	59	21	59	1 31
3	30	59	53	17	0 38	8	30	59	20	27	1 32
3	40	59	52	38	0 39	8	40	59	18	54	1 33
3	50	59	51	57	0 41	8	50	59	17	18	1 36
4	0	59	51	14	0 43	9	0	59	15	41	1 37
4	10	59	50	29	0 45	9	10	59	14	1	1 40
4	20	59	49	43	0 46	9	20	59	12	20	1 41
4	30	59	48	54	0 49	9	30	59	10	38	1 42
4	40	59	48	4	0 50	9	40	59	8	53	1 45
4	50	59	47	12	0 52	9	50	59	7	7	1 46
5	0	59	46	18	0 54	10	0	59	5	18	1 49

The eighth Rumbe { East: / West. from the meridian.

Latitude.		1. deg. of lon.			Differ.		Latitude.		1. deg. of lon.			Differ.	
Deg.	Mi.	min.	sec.	thir.	sec.	thir.	Deg.	Mi.	min.	sec.	thir	sec.	thir.
10	10	59	3	28	1	50	15	10	57	54	36	2	44
10	20	59	1	37	1	51	15	20	57	51	51	2	45
10	30	58	59	43	1	54	15	30	57	49	4	2	47
10	40	18	57	49	1	54	15	40	57	46	15	2	49
10	50	58	55	50	1	59	15	50	57	43	25	2	50
11	0	58	53	51	1	59	16	0	57	40	33	2	52
11	10	58	51	51	2	0	16	10	57	37	38	2	55
11	20	58	49	48	2	3	16	20	57	34	43	2	55
11	30	58	47	44	2	4	16	30	57	31	45	2	58
11	40	58	45	38	2	6	16	40	57	28	46	2	59
11	50	58	43	30	2	8	16	50	57	25	45	3	1
12	0	58	41	20	2	10	17	0	57	22	42	3	3
12	10	58	39	8	2	12	17	10	57	19	37	3	5
12	20	58	36	55	2	13	17	20	57	16	31	3	6
12	30	58	34	40	2	15	17	30	57	13	23	3	8
12	40	58	32	23	2	17	17	40	57	10	13	3	10
12	50	58	30	4	2	19	17	50	57	7	2	3	11
13	0	58	27	44	2	20	18	0	57	3	48	3	14
13	10	58	25	22	2	22	18	10	57	0	33	3	15
13	20	58	22	58	2	24	18	20	56	57	16	3	17
13	30	58	20	32	2	26	18	30	56	53	58	3	18
13	40	58	18	4	2	28	18	40	56	50	38	3	20
13	50	58	15	35	2	29	18	50	56	47	16	3	22
14	0	58	13	4	2	31	19	0	56	43	52	3	24
14	10	58	10	31	2	33	19	10	56	40	27	3	25
14	20	58	7	56	2	35	19	20	56	36	59	3	28
14	30	58	5	20	2	36	19	30	56	33	31	3	28
14	40	58	2	42	2	38	19	40	56	30	0	3	31
14	50	58	0	2	2	40	19	50	56	26	28	3	32
15	0	57	57	20	2	42	20	0	56	22	54	3	34

The eighth Rumbe from the meridian { Easts / Weest }

Latitude.		1. deg. of lon.		Differ		Latitude.		1. deg. of lon.		Differ.	
Deg.	Mi.	min.	sec. thir	sec.	thir.	Deg.	Mi.	min.	sec. thir.	sec.	thir.
20	10	56	19 18	3	36	25	10	54	18 16	4	26
20	20	56	15 40	3	38	25	20	54	13 48	4	28
20	30	56	12 1	3	39	25	30	54	9 18	4	30
20	40	56	8 20	3	41	25	40	54	4 47	4	31
20	50	56	4 38	3	42	25	50	54	0 14	4	33
21	0	56	0 53	3	45	26	0	53	55 40	4	34
21	10	55	57 7	3	46	26	10	53	51 3	4	37
21	20	55	53 20	3	47	26	20	53	46 25	4	38
21	30	55	49 30	3	50	26	30	53	41 46	4	39
21	40	55	45 39	3	51	26	40	53	37 5	4	41
21	50	55	41 48	3	31	26	50	53	32 22	4	43
22	0	55	37 52	3	56	27	0	53	27 37	4	45
22	10	55	33 55	3	57	27	10	53	22 51	4	46
22	20	55	29 58	3	57	27	20	53	18 4	4	47
22	30	55	25 58	4	0	27	30	53	13 14	4	50
22	40	55	21 57	4	1	27	40	53	8 23	4	51
22	50	55	17 54	4	3	27	50	53	3 31	4	52
23	0	55	13 49	4	5	28	0	52	58 37	4	54
23	10	55	9 43	4	6	28	10	52	53 41	4	56
23	20	55	5 35	4	8	28	20	52	48 44	4	57
23	30	55	1 25	4	10	28	30	52	43 44	5	0
23	40	54	57 14	4	11	28	40	52	38 44	5	0
23	50	54	53 1	4	13	28	50	52	33 42	5	2
24	0	54	48 46	4	15	29	0	52	28 38	5	4
24	10	54	44 29	4	17	29	10	52	23 32	5	6
24	20	54	40 11	4	18	29	20	52	18 25	5	7
24	30	54	35 52	4	19	29	30	52	13 17	5	8
24	40	54	31 30	4	22	29	40	52	8 7	5	10
24	50	54	27 07	4	23	29	50	52	2 55	5	12
25	0	54	22 42	4	25	30	0	51	57 41	5	14

The eighth Rumbe from the meridian { East. / West.

Latitude.		1. deg. of lon.		Differ.		Latitude.		1. deg. of lon.		Differ.	
Deg.	Mi.	min.	sec. thir.	sec.	thir.	Deg.	Mi.	min.	sec. thir.	sec.	thir.
30	10	51	52 26	5	15	35	10	49	2 56	6	1
30	20	51	47 10	5	16	35	20	48	56 53	6	3
30	30	51	41 52	5	18	35	30	48	50 49	6	4
30	40	51	36 32	5	20	35	40	48	44 43	6	6
30	50	51	31 11	5	21	35	50	48	38 36	6	7
31	0	51	25 48	5	23	36	0	48	32 28	6	8
31	10	51	20 24	5	24	36	10	48	26 18	6	10
31	20	51	14 58	5	26	36	20	48	20 6	6	12
31	30	51	9 30	5	28	36	30	48	13 53	6	13
31	40	51	4 1	5	29	36	40	48	7 39	6	14
31	50	50	58 31	5	30	36	50	48	1 23	6	16
32	0	50	52 58	5	33	37	0	47	55 5	6	18
32	10	50	47 25	5	33	37	10	47	48 46	6	19
32	20	50	41 47	5	36	37	20	47	42 26	6	20
32	30	50	36 13	5	36	37	30	47	36 4	6	22
32	40	50	30 34	5	39	37	40	47	29 41	6	23
32	50	50	24 54	5	40	37	50	47	23 16	6	25
33	0	50	19 13	5	41	38	0	47	16 50	6	26
33	10	50	13 30	5	43	38	10	47	10 23	6	27
33	20	50	7 45	5	45	38	20	47	3 54	6	29
33	30	50	1 59	5	46	38	30	46	57 23	6	31
43	40	49	56 12	5	47	38	40	46	50 52	6	31
33	50	49	50 23	5	49	38	50	46	44 18	6	34
34	0	49	44 32	6	51	39	0	46	37 44	6	34
34	10	49	38 40	5	52	39	10	46	31 7	6	37
34	20	49	32 46	5	54	39	20	46	24 30	6	37
34	30	49	26 51	5	55	39	30	46	17 51	6	39
34	40	49	20 55	5	56	39	40	46	11 11	6	40
34	50	49	14 56	5	59	39	50	46	4 29	6	42
35	0	49	8 57	5	59	40	0	45	57 46	6	43

The eighth rumbe from the meridian. East. West.

Latitude.		1. deg. of lon.	Differ.	Latitude.		1. deg. of lon.	Differ.
Deg.	Mi.	min. sec. thir.	sec. thir.	Deg.	Mi.	min. sec. thir.	sec. thir.
40	10	45 51 1	6 45	45	10	42 18 10	7 25
40	20	47 44 15	6 46	45	20	42 10 44	7 26
40	30	45 37 28	6 47	45	30	42 3 16	7 28
40	40	45 30 39	6 49	45	40	41 55 48	7 28
40	50	45 23 49	6 50	45	50	41 48 18	7 30
41	0	45 16 57	6 50	46	0	41 40 46	7 32
41	10	45 10 4	6 53	46	10	41 33 14	7 32
41	20	45 3 10	6 54	46	20	41 25 40	7 34
41	30	44 56 14	6 56	46	30	41 18 6	7 34
41	40	44 49 17	6 57	46	40	41 10 28	7 38
41	50	44 42 19	6 58	46	50	41 2 51	7 37
42	0	44 35 19	7 0	47	0	40 55 12	7 39
42	10	44 28 18	7 1	47	10	40 47 32	7 40
42	20	44 21 16	7 2	47	20	40 39 50	7 42
42	30	44 14 12	7 4	47	30	40 32 7	7 43
42	40	44 7 7	7 5	47	40	40 24 24	7 43
42	50	43 0 0	7 7	47	50	40 16 39	7 45
43	0	43 52 52	7 8	48	0	40 8 52	7 47
43	10	43 45 43	7 9	48	10	40 1 5	7 47
43	20	43 38 33	7 10	48	20	39 53 16	7 49
43	30	43 31 21	7 12	48	30	39 45 26	7 50
43	40	43 24 8	7 13	48	40	39 37 35	7 51
43	50	43 16 53	7 15	48	50	39 29 42	7 53
44	0	43 9 37	7 16	49	0	39 21 49	7 53
44	10	43 2 20	7 17	49	10	39 13 54	7 53
44	20	42 55 2	7 18	49	20	39 5 58	7 55
44	30	42 47 42	7 20	49	30	38 58 1	7 57
44	40	42 40 21	7 21	49	40	38 50 2	7 59
44	50	42 32 59	7 22	49	50	38 42 3	7 59
45	0	42 25 35	7 24	50	0	38 34 2	8 1

The eighth Rumbe { *East:* / *West.* } *from the meridian.*

Latitude.		1. deg. of lon.			Differ.		Latitude.		1. deg. of lon			Differ.	
Deg.	Mi.	min.	sec.	thir.	sec.	thir.	Deg.	Mi.	min.	sec.	thir.	sec.	thir.
50	10	38	26	0	8	2	55	10	34	16	17	8	36
50	20	38	17	57	8	3	55	20	34	7	41	8	36
50	30	38	9	53	8	4	55	30	33	59	4	8	37
50	40	38	1	47	8	6	55	40	33	50	25	8	39
50	50	37	53	41	8	6	55	50	33	41	46	8	39
51	0	37	45	33	8	8	56	0	33	33	6	8	40
51	10	37	37	24	8	9	56	10	33	24	24	8	42
51	20	37	29	14	8	10	56	20	33	15	42	8	42
51	30	37	21	3	8	11	56	30	33	6	58	8	44
51	40	37	12	52	8	12	56	40	32	58	14	8	44
51	50	37	4	37	8	14	56	50	32	49	28	8	46
52	0	36	56	23	8	14	57	0	32	40	42	8	46
52	10	36	48	7	8	16	57	10	32	31	55	3	47
52	20	36	39	50	8	17	57	20	32	23	6	8	49
52	30	36	31	32	8	18	57	30	32	14	17	8	49
52	40	36	23	13	8	19	57	40	32	5	26	8	51
52	50	36	14	53	8	20	57	50	31	56	35	8	51
53	0	36	6	32	8	21	58	0	31	47	43	8	52
53	10	35	58	10	8	22	58	10	31	38	49	8	54
53	20	35	49	46	8	24	58	20	31	29	55	8	54
53	30	35	41	22	8	24	58	30	31	21	0	8	55
53	40	35	32	56	8	26	58	40	31	12	3	8	57
53	50	35	24	29	8	27	58	50	31	3	6	8	57
54	0	35	16	2	8	27	59	0	30	54	8	8	58
54	10	35	7	33	8	29	59	10	30	45	9	8	59
54	20	34	59	3	8	30	59	20	30	36	9	9	0
54	30	34	50	32	8	31	59	30	30	27	8	9	1
54	40	34	42	0	8	32	59	40	30	18	6	9	2
54	50	34	33	27	8	33	59	50	30	9	4	9	2
55	0	34	24	53	8	34	60	0	30	0	0	9	4

The eighth Rumbe from the meridian } East: West.

Latitude.	1. deg. of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
60 10	29 50 55	9 5	65 10	25 11 56	9 30
60 20	29 41 50	9 5	65 20	25 2 25	9 31
60 30	29 32 43	9 7	65 30	24 52 54	9 31
60 40	29 23 36	9 7	65 40	24 43 22	9 32
60 50	29 14 28	9 8	65 50	24 33 49	9 33
61 0	29 5 19	9 9	66 0	24 24 15	9 34
61 10	28 56 09	9 10	66 10	24 14 41	9 34
61 20	28 46 58	9 11	66 20	24 5 6	9 35
61 30	28 37 46	9 12	66 30	23 55 30	9 36
61 40	28 28 34	9 12	66 40	23 45 53	9 37
61 50	28 19 20	9 14	66 50	23 36 16	9 37
62 0	28 10 06	9 14	67 0	23 26 38	9 38
62 10	28 0 51	9 15	67 10	23 16 59	9 39
62 20	27 51 35	9 16	67 20	23 7 20	9 39
62 30	27 42 18	9 17	67 30	22 57 40	9 40
62 40	27 33 00	9 18	67 40	22 47 59	9 41
62 50	27 23 41	9 19	67 50	22 38 17	9 42
63 0	27 14 22	9 19	68 0	22 28 35	9 42
63 10	27 5 02	9 20	68 10	22 18 52	9 43
63 20	26 55 41	9 21	68 20	22 9 9	9 43
63 30	26 46 19	9 22	68 30	21 59 24	9 45
63 40	26 36 56	9 23	68 40	21 49 39	9 45
63 50	26 27 33	9 23	68 50	21 39 54	9 45
64 0	26 18 08	9 25	69 0	21 30 7	9 47
64 10	26 8 43	9 25	69 10	21 20 21	9 47
64 20	25 59 17	9 26	69 20	21 10 33	9 48
64 30	25 49 50	9 27	69 30	21 0 45	9 48
64 40	25 40 23	9 27	69 40	20 50 56	9 49
64 50	25 30 55	9 28	69 50	20 41 6	9 50
65 0	25 21 26	9 29	70 0	20 31 16	9 50

The eighth Rumbe from the meridian. } *East: West.*

Latitude.		*1. deg. of lon.*			*Differ.*		*Latitude.*		*1. deg. of lon.*			*Differ.*	
Deg.	*Mi.*	*min.*	*sec.*	*thir*	*sec.*	*thir.*	*Deg.*	*Mi.*	*min.*	*sec.*	*thir.*	*sec.*	*thir.*
70	10	20	21	26	9	50	75	10	15	21	38	10	7
70	20	20	11	34	9	52	75	20	15	11	30	10	8
70	30	20	1	42	9	52	75	30	15	1	22	10	8
70	40	19	51	50	9	52	75	40	14	51	14	10	8
70	50	19	41	56	9	54	75	50	14	41	5	10	9
71	0	19	32	3	9	54	76	0	14	30	55	10	10
71	10	19	22	8	9	55	76	10	14	20	45	10	10
71	20	19	12	13	9	55	76	20	14	10	35	10	10
71	30	19	2	17	9	56	76	30	14	0	24	10	11
71	40	18	52	22	9	55	76	40	13	50	13	10	11
71	50	18	42	25	9	57	76	50	13	40	1	10	12
72	0	18	32	28	9	57	77	0	13	29	49	10	12
72	10	18	22	30	9	58	77	10	13	19	37	10	12
72	20	18	12	31	9	59	77	20	13	9	24	10	13
72	30	18	2	23	9	59	77	30	12	59	11	10	13
72	40	17	52	33	9	59	77	40	12	48	57	10	14
72	50	17	42	33	10	0	77	50	12	38	43	10	14
73	0	17	32	32	10	1	78	0	12	28	29	10	14
73	10	17	22	31	10	1	78	10	12	18	14	10	15
73	20	17	12	29	10	2	78	20	12	7	59	10	15
73	30	17	2	27	10	2	78	30	11	57	43	10	16
73	40	16	52	24	10	3	78	40	11	47	27	10	16
73	50	16	42	21	10	3	78	50	11	37	11	10	16
74	0	16	32	18	10	3	79	0	11	26	55	10	16
74	10	16	22	13	10	3	79	10	11	16	37	10	18
74	20	16	12	9	10	4	79	20	11	6	20	10	17
74	30	16	2	3	10	6	79	30	10	56	3	10	17
74	40	15	51	58	10	5	79	40	10	45	45	10	18
74	50	15	41	52	10	6	79	50	10	35	27	10	18
75	0	15	31	45	10	7	80	0	10	25	08	10	19

The eighth rumbe from the meridian. } East: West.

Latitude.	1. deg. of lon.	Differ	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
80 10	10 14 49	10 19	85 10	5 3 20	10 26
80 20	10 4 30	10 19	85 20	4 52 53	10 27
80 30	9 54 10	10 20	85 30	4 42 27	10 26
80 40	9 43 50	10 20	85 40	4 32 1	10 26
80 50	9 33 30	10 20	85 50	4 21 34	10 27
81 0	9 23 10	10 20	86 0	4 11 7	10 27
81 10	9 12 49	10 21	86 10	4 0 41	10 26
81 20	9 2 28	10 21	86 20	3 50 14	10 27
81 30	8 52 7	10 21	86 30	3 39 46	10 28
81 40	8 41 45	10 22	86 40	3 29 19	10 27
81 50	8 31 23	10 22	86 50	3 18 52	10 27
82 0	8 21 1	10 22	87 0	3 8 25	10 27
82 10	8 10 39	10 22	87 10	2 57 57	10 28
82 20	8 0 16	10 23	87 20	2 47 29	10 28
82 30	7 49 54	10 22	87 30	2 37 2	10 27
82 40	7 39 31	10 23	87 40	2 26 34	10 28
82 50	7 29 7	10 24	87 50	2 16 6	10 28
83 0	7 18 44	10 23	88 0	2 5 38	10 28
83 10	7 8 20	10 24	88 10	1 55 10	10 28
83 20	6 57 56	10 24	88 20	1 44 42	10 28
83 30	6 47 32	10 24	88 30	1 34 14	10 28
83 40	6 37 8	10 24	88 40	1 23 46	10 28
83 50	6 26 43	10 25	88 50	1 13 18	10 28
84 0	6 16 18	10 25	89 0	1 2 50	10 28
84 10	6 5 53	10 25	89 10	0 52 21	10 29
84 20	5 55 28	10 25	89 20	0 41 53	10 28
84 30	5 45 3	10 25	89 30	0 31 25	10 28
84 40	5 34 37	10 26	89 40	0 20 56	10 29
84 50	5 24 10	10 27	89 50	0 1 28	10 28
85 0	5 13 46	10 27	90 0	0 0 0	0 0

Chap. X.

The vse of this Table of Rumbs.

THe especiall vse of this table is for the true drawing of the rumbes in the globe and in the chart, which some (with a name astonishing with an emptie sound) call paradoxall: but to speake plaine english, it is nothing else but a chart, whose center is the pole, and may best bee made after the kinde of proiection vsed by *Gemma Frisius* in his generall Astrolabe: wherein the meridians will be right lines passing by the center, and the parallels peripheries of a circle: supposing one halfe of the sphæricall superficies of the terrestriall globe to be proiected into the plaine of the æquinoctial. Whose principall vse may be in our Northerly nauigations and discoueries, wherein the rumbes may most easily and truly be drawne by helpe of this table, thus: Hauing an Index hanged vpon the center, and graduated with degrees of latitude, with figures set to euerie fifth or tenth degree, beginning at the æquinoctiall: hauing also diuided the æquinoctiall into degrees of longitude, beginning at the first meridian, lay the Index to euery degree of longitude in order one after another; looking alwaies withall in this Table, the latitudes of the rumbe you desire to describe, and at the same latitudes found in the fiduciall line of the Index, make pricks in the chart, for by these pricks, the hælisphæricall line or rumbe desired must be drawne.

After

After the same manner must you worke with the Globe, hauing first truly hanged it vpon his poles within his meridian diuided into degrees, and subdiuided also into smaller parts (if roome will serue) with numbers set to euery fifth, or tenth degree frō the æquinoctiall to the Pole, and then proceeding in all points, as before you did, with the chart, only vsing the Meridian in stead of the Index.

Hereby also the rumbes may most exactly be described in those distorted hart-formed maps of *Orontius* and *Vopelius*, or in any other amongst *Ptolemees* or *Ortelius* his Geographical Tables, or any else whatsoeuer, so it be first distinguished by meridians & parallels, wherby the longitude & latitude of any point assigned therein may be readily found; seeing it may easily be knowne out of this Table by what points of longitude and latitude each rumbe must be drawne from the æquinoctial to the Pole almost. But those two kindes of proiection before mentioned, I meane of the nauticall Planisphære, and *Gemma Frisius* his Astrolabe, are such as of all others doe best represent in a plaine, the true formes of all places that are vpon the sphæricall face of the earth.

The vse of the table of the eighth rumbes

The table of the eighth Rumbe serueth to shew how many minutes, seconds and thirds of one degree of the æquinoctiall, are conteined in one degree of longitude for euery tenth minute of latitude: whereby the whole table of Rumbs may be made and examined more truly, and easily, then by that of *Appian*, lately set foorth by *Simon Steuin* in his *Hypomnemat. Mathemat.*

Chap. XI.

A most plaine and sensible demonstration of the agreement of the Nauticall Planisphære, before described, with the Globe; and of the disagreement of the common Sea-chart from them both.

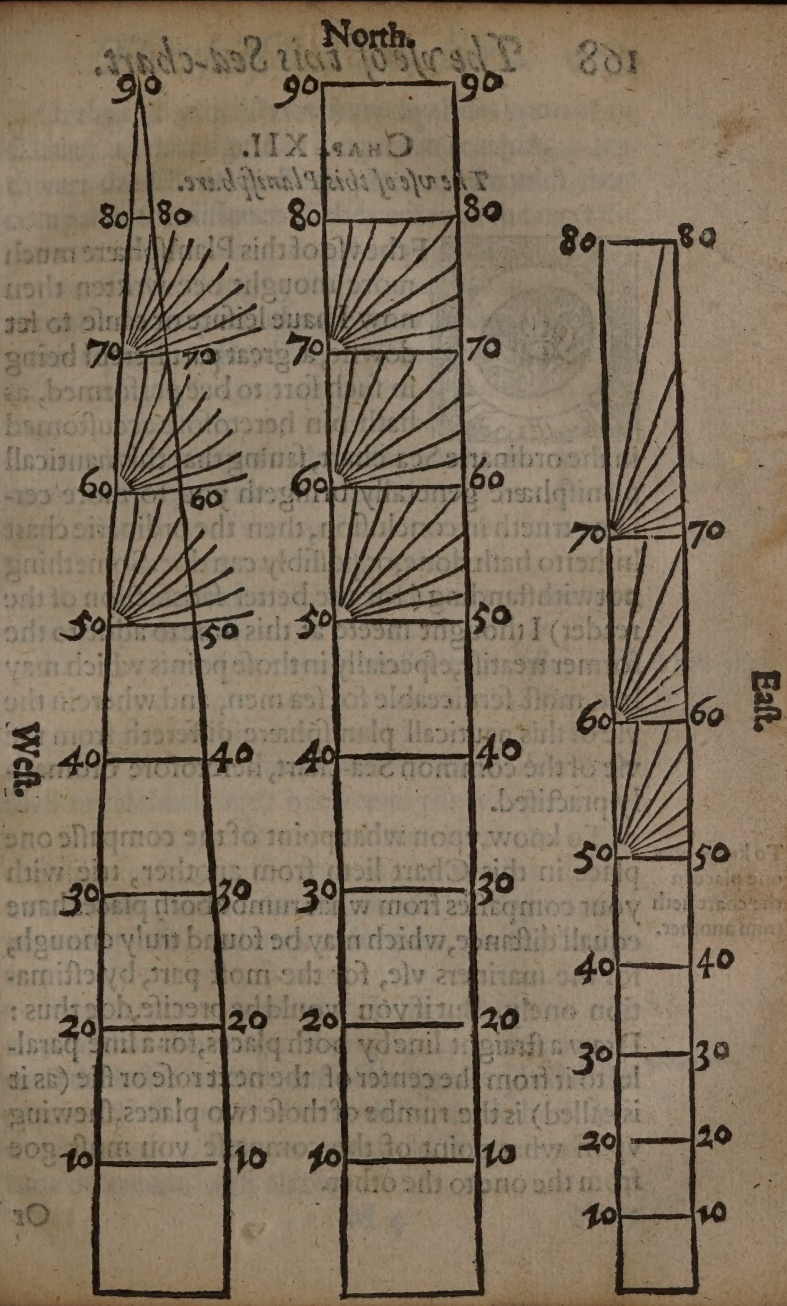
HAuing thus shewed the manifold vses of the table of Latitudes, aswell for ỹ true graduating of Sea-charts both generall and particular, with degrees of latitude increasing in their due proportion, as also for the making of the table of Rumbes, together with the vse thereof; I will now come againe to the matter, and marke principally intended and aimed at in this first book, and shew how greatly the common Sea-chart (with parallel meridians and degrees of latitude euerie where equal) doth differ from the truth, as also how well the chart, before described, agreeth with the same; which may most manifestly appeare by comparing together these three figures following, whereof the first is in all points answerable to a part of a sphæricall superficies, conteined betwixt two meridians, differing in longitude ten degrees, and extended from the æquinoctiall to the Pole. The second conteineth ten degrees in longitude, and 90 degrees from the æquinoctiall in latitude, of the common Sea-chart with equidistant meridians and degrees of latitude euery where equall. The third conteineth 10 degrees in longitude, and 80 in latitude of the nauticall Planisphære, truly described with

with meridians in all places æquidistant, and degrees of latitude increasing proportionally towards the pole, as before we haue shewed.

Now all the other parts of the Globe or Charts are like vnto these; therefore what agreement or disagreement is found in these parts must needes be also in their wholes. The first figure is a part of the Globe, and therefore in all things sheweth the very trueth: therefore wee make it the rule to examine the rest by, for so farre forth as they agree with it, they are true, and as much as they differ from it, they are false. Now therefore let vs bring them to examination.

If there be two places differing in longitude and latitude 10 degrees (that which hath the greater latitude being more to the Eastwards) the second figure (as you see) maketh them lie each from other Northeast and Southwest, in what latitude soeuer they be situate, either neerer or further from the æquinoctiall, as in 50 and 60, or in 60 and 70; or in 70 and 80 degrees of latitude. But in the first and third figure, these places shall beare almost Northeast and Southwest each from other, at the æquinoctiall onely. And one place being situate in 50, and the other in 60 degrees of latitude, they shall lie one from another Northeast and by North, and almost halfe a point Northerly. In 60 and 70 degrees of latitude they lie almost North Northeast: in 70 and 80 they beare each from other scarce so much as North and by East. Therefore the common Sea-chart, in shewing how one of those places beareth from another, erreth in the first one point of the

compasse and almost an halfe; in the second, two whole points almost; but in the third, more then three whole points. Neither is it possible to auoide these so grosse and intollerable errors (if the rumbs be right lines, and the degrees of longitude and latitude euery where equall) but wee must needes fall into other errors as grosse as these, either in the difference of longitudes, or in the difference of latitudes, or in the respectiue situation, which they commonly call, the lying or bearing of them one from another, as may most plainly appeare by comparing the common sea-chart and the Globe together. But in this nauticall planisphære heretofore described, all these errors are auoided, aswell in the longitudes and latitudes, as also in the directionall distances and respectiue situations of all places, each from other according to the points of the compasse, as by like comparison of it with the Globe, will be most manifest.


North.
90
90
90
80
80
80
80
70
70
70
70
60
60
60
60
50
50
50
50
40
40
40
40
30
30
30
30
20
20
20
20
10
10
10
10
West.
East.

Chap. XII.

The vse of this Planisphære.

OF the vse of this Planisphære much more mought bee written then now I haue leisure or cause to set downe, a great part hereof being in such sort to bee performed, as hath bin heretofore accustomed in the ordinarie Sea-chart, sauing that this nauticall planisphære generally bringeth you to more certaine trueth in conclusion, then the ordinarie chart hitherto hath done, or possibly can doe. Something notwithstanding (for the better satisfaction of the reader) I thought meete at this time to adde to the former treatise, especially in those points which may bee most seruiceable for sea men, and wherein the vse of this nauticall planisphære differeth from the vse of the common Sea-chart, heretofore ordinarily practised.

To know how one place in the chart lieth from another.

To know vpon what point of the compasse one place in this Chart lieth from another, trie with your compasses from what rumbe both places haue equall distance, which may be found truly enough, for the mariners vse, for the most part, by estimation onely. But if you would be precise, doe thus: Draw a straight line by both places, for a line parallel to it from the center of the next rose or flie (as it is called) is the rumbe of those two places, shewing vpon what point of the compasse you must goe from the one to the other.

Or

Or thus, (if you list not draw any lines vpon your Chart) lay the edge of a long ruler (reaching ouerthwart the Chart) to both places: take with your compasses the distance of the center of the next flie from the edge of the ruler, then guiding and carrying one foote along by the edge of the ruler, leade the other foote parallel-wise (that is, keeping it alwaies equally at that distance from the ruler) for so it sheweth you how those places lie one from another.

To finde the distance of places in their rumbe.

The distance of two places (as the mariners commonly take it, and measure it in their Charts) is the segment or part of the rumbe conteined betweene them; which how much it is in the ordinarie measure of leagues, shall truly be found out by this planisphære, thus:

If both places haue one latitude.

If both places haue the same latitude, take with your compasses the length of a degree of the meridian at that latitude (take halfe the degree aboue, and halfe beneath that latitude) for so oft as you shall finde that length betweene the two places, so many score leagues are there betwixt them. If the distance bee great, for the more expedition, you may take fiue times the length of that degree, and counting it for an hundred leagues, proceed as before.

If both places haue the same longitude.

If both places haue not the same latitude, the equinoctial also not comming betweene them, subtract the lesser latitude out of the greater; but if the æquinoctiall come betwixt them, adde both latitudes together, so haue you the difference of latitude betweene both places.

Now if both places haue the ſame longitude, ſo many degrees as there is in the difference of latitude, ſo many ſcore leagues is the diſtance.

If both places differ both in longitude and latitude.

But if they differ alſo in longitude as well as in latitude, looke how many degrees the difference of latitude containeth, ſo many degrees of the æquinoctiall take with your compaſſes, and leading one foote in the æquinoctiall, moue forwards the other alſo parallel-wiſe, keeping alwaies that diſtance, till it croſſe the rumbe of thoſe two places, in ſuch ſort, that one foote reſting in that croſſing, the other caried about, may but onely touch the æquinoctiall. Then hauing taken with your compaſſes the ſegment or part of that rumbe betweene that croſſing and the æquinoctiall, ſet both feete in the æquinoctiall, and ſee how many degrees are contained betwixt them, for ſo many ſcore leagues is the diſtance of thoſe two places.

Or if that ſegment of the ſaid rumbe bee greater then well can be taken with the compaſſes, take the length of fiue degrees of the æquinoctiall, between the feete of your compaſſes, and looke how oft you can finde that length in the ſegment aforeſaid of the rumbe, for ſo many hundreth leagues is the diſtance of thoſe two places.

The demonſtration of the truth of the former rules.

The demonſtration hereof cannot be obſcure to him that well conſidereth the geometricall reaſon of the proiection, and making of this nauticall planiſphære, before ſet downe in the ſecond chapter; from whence it followeth, that becauſe the ſphæricall ſuperficies (whereof this planiſphære is conceiued to bee geometrically made) extendeth it ſelfe

euery way equally, at euery point of latitude betwixt the æquinoctiall and pole, till it applie and ioyne it selfe round about to the concauitie of the circumscribed cylinder, therefore the segments of the meridian, and of any other rumbe contained betwixt any the same two parallels, must needs increase in one and the same proportion.

And consequently, as often as the segment of a meridian betweene any two parallels, is contained in the segment of any rumbe intercepted betwixt the same parallels in the Globe, so often is the like segment of a meridian contained in the segment of the same rumbe intercepted betweene the parallels correspondent in this planisphære. Therefore (supposing the said segment of the meridian in this planisphære, to be diuided into so many equall parts as it containeth degrees) it followeth, that so often as one of these parts is contained in the segment of the rumbe aforesaid in this planisphære, so many score leagues is the distance of the two places set at the ends of that segment.

Now it is manifest, that by these three segments, that is, the segment of the rumbe betweene the two places, the segment of the meridian betwixt one of the places, and the parallel of the other (that is, the difference of latitude) and the segment of the parallel contained betwixt one of these places, and the meridian of the other (which is the difference of longitude) I say it is manifest, that by these three segments a right angled triangle is made, because the segments of the meridian and parallel (which are two sides of this triangle) include a right angle.

Againe

Againe it is plaine, that taking with your com paſes ſo many degrees of the æquinoctiall as are conteined in the difference of latitude: then guiding one foote in the æquinoctiall, and carrying forwards the other parallel-wiſe, till it croſſe the rumbe of thoſe two places, in ſuch ſort, that one foote of the compaſſes being ſet in that croſſing, the other moued about, may but only touch the æquinoctial: and laſtly, drawing from that croſſing a line perpendicular to the æquinoctial: It is plaine, I ſay, that by this perpendicular and the two ſegments (one of the æquinoctial, betweene this perpendicular and the rumbe; the other of the rumbe, betweene the perpendicular and the æquinoctiall): by theſe ſegments, I ſay, and the ſaid perpendicular, there is comprehended another right angled Triangle: which by the 14. *e* 4, *&* *c.* 3. *e.* 7 *Ram.* is like to the former right angled Triangle, becauſe two angles of them both are æquall, that is, the right angles, and the angles of the ſame rumbe. In the laſt of theſe Triangles, the ſide perpendicular to the æquinoctiall, is proportionall to the difference of latitude, and the ſegment of the rumbe betweene the end of this perpendicular and the æquinoctiall, is proportionall to the ſegment of the ſame rumbe conteined betwixt the two places. Therefore by the 2 *p* 6. *&* 17 *p.* 11 *Eucl.* becauſe the line perpendicular to the æquinoctiall, conteineth ſo many equal degrees of the æquinoctiall, as there are equall parts in the difference of latitude (that is) ſo many as there are degrees in the difference of latitude: theſe equall parts alſo of the perpendicular and difference

rence of latitude are proportionall. Whereof it followeth, that so oft as one of these equall parts of the difference of latitude is conteined in the segment of the rumbe betwixt the two places (which before we shewed to be so oft as a degree of the meridian in the globe, is conteined in the segment of the rumbe betwixt the same places in the globe) so oft is one of the said equall parts of the perpendicular aforesaid (that is a degree of the æquinoctiall) conteined in the segment of the same rumbe betweene the foresaid crossing or end of the perpendicular, and the æquinoctiall. Therefore look how many degrees of the æquinoctiall there are found in the segment of the rumbe of the two places, so many score leagues is the distance of those two places, which was to be demonstrated.

Thus haue you a way infallible to finde out the distance between any two places measured in their rumbe: which because it is then onely their true distance (that is the shortest space betwixt them vpon the superficies of the terrestriall globe) when both places lie North and South each from other, or East and West, hauing no latitude, as vnder the æquinoctiall; whereas otherwise the segment of the rumbe betweene the two places is alwaies greater then the true distance (yea sometime by halfe and more, in places far Northward, or Southward) I thought good also here to set downe the way to finde out the true distance of any two places, according to the arch of a great circle drawne betweene them, wherein I haue been, and yet am publikely charged with my promise, and meane at this time to discharge my selfe thereof.

The

The true distance betweene two places, is the arch of a great circle contained betwixt them, which is thus to be found out:

If both places haue no latitude (as when they are both vnder the æquinoctiall) and one of them also no longitude, the longitude of the other being lesse, or not more then 180 degrees; the longitude is the distance;

But if the longitude be greater then 180 degrees, subtract it out of 360; the remainder is the distance.

If both places haue either none, or the same longitude (as when they are in the same semicircle of the meridian betweene the poles) and one of them onely haue latitude; that latitude is the distance. But if both places agreeing in longitude haue latitudes also of like denomination (as both Northerly, or both Southerly) subtract the lesser latitude out of the greater, the distance remaineth: If one place haue Northerly latitude, and the other Southerly, adde them together; for the summe is the distance.

If one or both places haue latitude, and differ also in longitude: in a great circle diuided exactly into degrees (with figures set to euery fifth or tenth degree) note the longitudes of both places.

Now

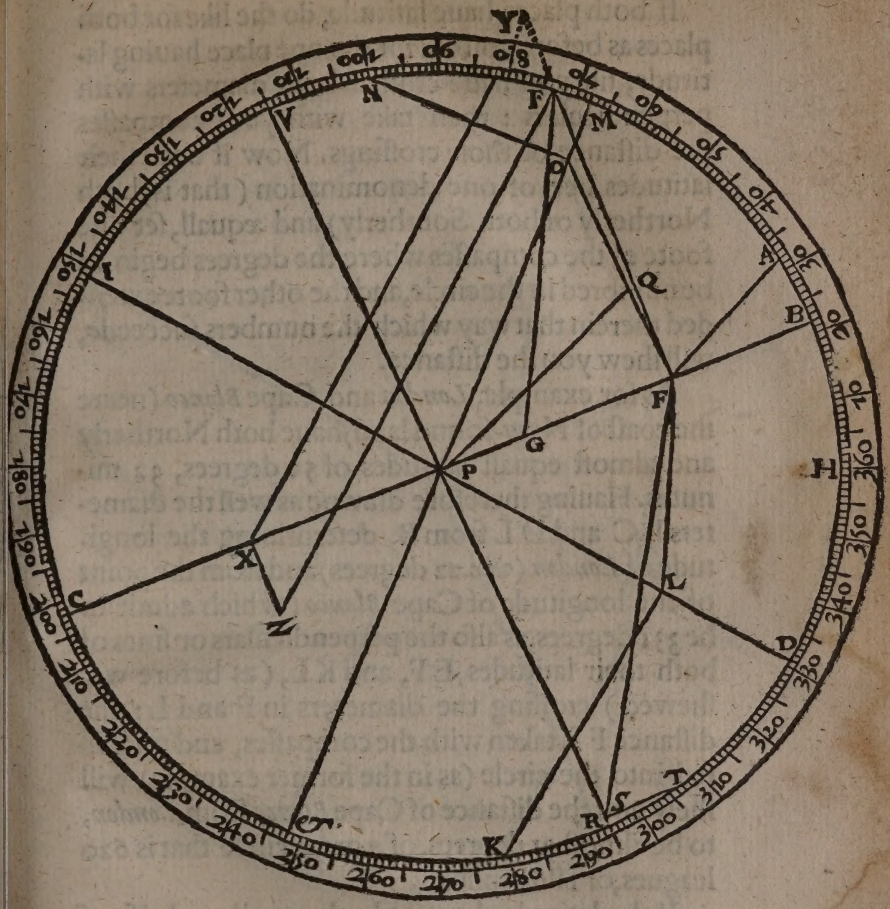
Now if one place only haue latitude, draw a diameter from the longitude thereof, noted in the circle, and with your compasses take so many degrees and minutes in the same circle, as that latitude containeth: then setting one foote of the compas-

ses

ſes in the longitude of that place, with the other make a pricke in the circle, which may be called the point of latitude. From this point draw a line perpendicular, croſſing the diameter drawne from the longitude of that place. Take with your compaſſes the diſtance of this croſſing, from the point of the other places longitude, noted in the circle, and leauing one foote in the ſaid croſſing, with the other make a pricke, in the foreſaid diameter: take the diſtance of this pricke from the point of latitude noted in the circle. Then ſetting one foote of the compaſſes in that point of the circle where the degrees begin to be numbred, the other foote extended that way, which the numbers proceed, ſhall ſhew you in the circle the diſtance of the places.

Take for example the Citie of *London*, and Saint *Thomas* Iland, which lieth right vnder the æquinoctial line, in 32 degrees of longitude. The longitude of *London* admit to be 22 degrees, the latitude 51 degrees, 32 minutes. Marke the longitudes of Saint *Thomas* Iland and of *London* with A and B. From the longitude of *London* (becauſe *London* hath alſo latitude) draw the diameter B C. Hauing taken with the compaſſes the latitude of *London* in the circle, ſet one foote in B, and with the other make the prick E in the circle, and draw the perpendicular E F, croſſing the diameter B C at F. Make F G equall to F A, which is the diſtance of Saint *Thomas* Iland from the ſine of *Londons* latitude. Then G E ſhall be the line ſubtending the diſtance of thoſe two places. Taking therefore the length of G E with the compaſſes, and ſetting one foote in H (where the

degrees



degrees begin) the other ſtretched forwards in the circle, will point you out the diſtance of Saint *Thomas* Iland and *London*, 52 degrees of a great circle, and about one halfe, that is, 1050 leagues, or 3150 Engliſh miles.

If both places haue latitude, do the like for both places as before you did for the one place hauing latitude, till you haue crossed both diameters with perpendiculars: then take with your compasses the distance of those crossings. Now if both their latitudes bee of one denomination (that is, both Northerly or both Southerly) and æquall, set one foote of the compasses where the degrees begin to be numbred in the circle, and the other foote extended therein that way which the numbers succeede, will shew you the distance.

As for example, *London* and Cape *Blanco* (neere the coast of New-found land) haue both Northerly and almost equall latitudes of 51 degrees, 32 minutes. Hauing therefore drawne as well the diameters B C and D L from B, determining the longitude of *London* (*viz.* 22 degrees) and from the point of the longitude of Cape *Blanco* (which admit to be 331 degrees, as also the perpendiculars or sines of both their latitudes, E F, and K L, (as before was shewed) crossing the diameters in F and L: the distance F L taken with the compasses, and translated into the circle (as in the former example) will shew you the distance of Cape *Blanco* from *London*, to be almost 31 degrees, of a great circle that is 620 leagues, or 1860 miles.

If the latitudes bee not both equall, and also of one denomination, leauing one foote of the compasses in the crossing of the sine or perpendicular descending from the point of the greater latitude, with the other foote make a pricke in the same diameter, wherin that crossing is: then if the latitudes

be

be both of one denomination, take with the compasses the length of ŷ perpendicular or sine drawne from the point of the lesser latitude: and setting one foote in the point of the greater latitude, with the other make a prick in the perpendicular descen-

ding from it, that is, in the fine thereof: Take the distance of this pricke from the former, made in the diameter: This distance transferred into the circle (as in the first example) will giue you the distance of the places giuen.

As *London* and *Hierusalem* haue both Northerly and vnequall latitudes, *Hierusalems* latitude being onely 32 degrees. First therefore note in the circle both their longitudes: the longitude of *London* (*viz.* 22 degrees) as before with B: The longitude of *Hierusalem* (68 degrees) note with M: Let the perpendicular or the fines of the latitudes of *London* and *Hierusalem*, E F, and N O be drawne as in the former examples. Make F P equall to O F, and P Q equall to N O: The space betwixt P and Q taken with the compasses, and then both feete set in the circle (in such sort as in the first example was shewed) shal conteine between them the desired distance of *Hierusalem* from *London*, 38 degrees, and about $\frac{1}{4}$, that is 775 leagues, which are 2325 miles.

But if the latitudes be of diuers denominations, (that is, one Northerly, and the other Southerly) continue foorth the perpendicular (that crosseth the diameter, wherein the foresaid prick was made) till it bee equall to both perpendiculars, that is, to the fines of both latitudes. The distance of the end of this continued perpendicular from the pricke aforesaid in the diameter, taken with the Compasses, and translated into the graduated peripherie of the circle (as before) will shew you how many degrees of a great circle are contained betweene both places.

To

To shut vp this matter with one example, suppose you would know how farre *Cusco* in *Peru* is from *London*. Let the longitude of *Cusco* be 295 degrees, the latitude 11 degrees Southerly: The longitude of *London*, as before, 22 deg. the latitude 51 de-

grees, 32 minutes. From both these longitudes noted in the circle with B and R, draw the diameters, as before, B C, and R V: as also the perpendiculars or sines of their latitudes E F, and T S: Make F X equall to F S, the distance of those sines, and E Y equall to S T the sine of *Cuscoes* latitude. Take the distance X Y betweene the feete of the Compasses, and set them both in the circumference of the circle, as in the first example, so shall you finde that there are betwixt *London* and *Cusco* almost 97 degrees, of a great circle that is 1940 leagues, or 5820 miles.

If you had rather keepe within the compasse of the circle, make the perpendicular X Z equall to S T, and proceede with E Z, as you did before with X Y.

He that desireth a demonstration of the former rules, must suppose the circle A B H D R and C to be the equinoctiall circle: let him also vnderstand the sines of latitude E F, K L, N O, T S, to stand perpendicularly erect from their diameters of longitude B C, D I, M, and V R, and from the plaine of the æquinoctial; and consequently by the 3 e. 21. Ra. or 4. pr. 11. *Eucl.* frō the lines F A, F L, F O, F S, which lines are imagined to be in the plaine of the æquinoctiall, and are the distances of the sines of latitude. Therefore if F G bee made equall to F A, (which is a line drawne in the plaine of the æquinoctiall from S. *Thomas* Iland to the sine of *Londons* latitude) E G must needs be equall to the line subtending the distance of *London* and S. *Thomas* Iland by the 2. e. 7. Ra. 4. 26. pr. 1. *Eucl.*

Also,

Alſo, becauſe all the ſines of latitude (being perpendicular to the ſame plaine of the æquinoctiall) are parallels, by the 5. e 21. *Ram.* 6. pr. 11. *Eucl.* Therfore by the 11. e 2. *Ram.* or 35. d. 1. *Eucl.* F L is the line ſubtending the diſtance of London and Cape Blanco.

Againe, becauſe F P whereto E F is perpendicular is made equall to F O, (the diſtance of the ſines of London and Hieruſalem, to which (diſtance) E F is alſo perpendicular in the Globe) and E Q alſo equall to N O: Therefore F Q being the difference of the ſines of Londons and Hieruſalems latitudes, there muſt needes be the ſame diſtance betwixt P and Q that there is betweene the tops of the ſines of Hieruſalems and Londons latitudes in the Globe.

Laſtly, F X being equall to F S (the diſtance of the ſines of latitude of London and Cuſco in Peru) and X Z perpendicular to F X, and æquall to S T the ſine of Cuſcoes latitude: as E F is the ſine of Londons latitude and perpendicular to the ſame line X F: E Z (to which X Y is equall by the 6. c. 12. e 5 *Ram.* 33. pr. 1. *Eucl.* Y E being equall and parallel to X Z) muſt needes bee equall to a ſtreight line extended within the Globe betweene the points of latitude of Cuſco and London.

Now out of this demonſtration it were an eaſie matter (if any liſt take the paines to bee ſo curious) to finde out the diſtance of any two places arithmetically by the doctrine of triangles, hauing alwaies two ſides giuen which are the ſines of the complements of the latitudes of the two places, as O P,

FP: LP, FP: RP, FP: AP, FP: together with the angle conteined betweene them, that is the difference of their longitudes: whereby FA: FO: FL: FS, the distances of the sines of latitude being found by the 2, 3, 4, 5, *Copernic. de Triang. planis*, the lines also subtending the distances of the places may most easily be found by the 3. *Copernic. de Triang. plan.* For the squares of the distance of the sines, and of the difference of the sines of their latitudes (if both be Northerly or both Southerly) or of the summe of the sines of their latitudes (if one bee Northerly, another Southerly) are equall to the square of the line subtending the distance of the places 5. e 12. *Ram.* 47. pr. 1. *Eucl.*

With no lesse facilitie also by helpe of the former Tables, and the Canon of Triangles, any two places being giuen, there may arithmetically and most exactly be found out, first, by their longitudes and latitudes, the rumb, and distance measured in the rumbe: secondly, by their distance, and latitudes, the rumbe and difference of longitude: thirdly, by their rumbe, and latitudes, the distance and difference of longitude: fourthly, by their longitudes, rumbe, and one latitude, the other latitude and distance: fiftly, by the rumbe distance and one latitude, the other latitude, and the difference of longitude; or any other nauticall or geographicall probleme that by the Chart may mechanically be performed: and the whole Art of Nauigation Arithmeticall (as some call it) may as easily bee practised: So as, hauing onely the longitudes and latitudes of the places (by which, and to which you

are

are to saile) set down in a Table, you may by Arithmeticall calculation only (if you list take the paines) without any Chart, Mappe, or Globe, shew the course and distance from any place to other: and so giue most exact direction for the performance of an whole voiage to any knowne place assigned, how oft soeuer you haue trauersed or been tossed this way, and that way, by reason of scant, violent, or contrarie winds, or any other occasion.

But seeing the first grounds of this Art, that is, the obseruations of the latitudes, but especially of the courses at Sea, cannot but bee farre from such exquisite truth as is to be found in those Arithmeticall operations: how exact soeuer you bee in the rest of the meanes, you can looke for no more truth in conclusion then such as is answerable to the first grounds and principles, out of which the conclusion is gathered. So as the Mariner shall not neede to trouble himselfe any further herewith, but only to cast vp his accounts vpon the Chart trulie made (as before is shewed) which of all other is most fit and readie for his ordinarie vse. Now therefore it may bee sufficient, onely to shew how the former Problemes may mechanically be performed vpon the nauticall planisphære before described.

1. By the longitudes and latitudes of two places, to find the rumb and distance.

First, by the longitudes and latitudes of both places giuen, the rumbe and distance may thus be found: Draw parallels by both latitudes: take the distance of those parallels: according to which distance draw a parallel to the æquinoctiall. Then from the end of the difference of longitude, reckoned from the concurse of the rumbes in the æquinoctial,

noctial, erect a perpendicular crossing the said parallel: A line drawne by this crossing from the concurse of the rumbes is the rumbe of the two places. Now to finde out the distance, take so many degrees of the æquinoctial as the difference of latitude conteineth: and guiding one foote of the compasses in the æquinoctial, with the other foote carried parallel-wise at equall distance from the æquinoctial, crosse the rumbe newly found out: take the distance of this crossing from the concurse of the rumbes, and set both feete of the Compasses in the æquinoctiall, for the degrees conteined betweene them shew you the distance desired.

2. By the distance and latitudes, to find the rumbe and difference of longitude.

Secondly, by the distance and latitudes (knowing which place is more Eastwards, or Westwards) the rumbe and difference of longitude is thus found: Take with the compasses so many degrees and minutes of the æquinoctial, as the difference of latitude conteineth: According to that distance draw a parallel to the æquinoctial; take so many degrees of the æquinoctial with your Compasses as the distance giuen commeth to: then one foote being set in the concurse of the rumbes in the æquinoctiall, with the other crosse the parallel aforesaid: A line drawne by that crossing from the concurse of the rumbes in the æquinoctiall giueth you the rumbe desired. Then both latitudes being noted in the graduated meridian, therein take their difference with the compasses, and guiding one foote in the æquinoctiall, with the other carried at that distance parallel-wise from the æquinoctiall, crosse the rumbe of the two places: the distance of that

crossing

crossing from the meridian (that commeth from the common meeting of the rumbes in the æquinoctiall) taken with the compasses, and brought to the æquinoctiall, shall there shew you the difference of longitude. Or a perpendicular to the æquinoctiall from that crossing shall point you out therein, the difference of longitude.

Thirdly, by the rumbe and latitudes (being both Northerly or both Southerly) the distance and difference of longitude is thus found: Take the difference of latitudes in the æquinoctiall: according to that distance draw a parallel to the æquinoctiall (as before) crossing the rumb of the two places giuen: take the distance of this crossing from the concurse of the rumbes: Then both feete of the compasses set in the æquinoctiall will shew the distance of the places. The difference of longitude is found as before.

3. By the rumb and latitudes to finde the distance and difference of longitude.

Fourthly, by the longitudes, rumbe, and one latitude (knowing whether it bee the lesser or greater) to finde the other latitude, and the distance, doe thus: From the point of concurse of the rumbes in the æquinoctiall count the difference of longitude: from hence erect a perpendicular crossing the rumbe: the distance of this crossing from the æquinoctiall translated into the graduated meridian (setting one foote in the knowne latitude, and extending the other Northwards or Southwards according as the vnknowne latitude is greater or lesser) shall shew you the latitude desired. Now to finde the distance, worke as before in the first Probleme.

4. By the longitudes, rumb, and one latitude, to finde the other latitude and the distance.

Fiftly,

5. By the rũbe, the distance, and one latitude, to finde the other latitude and the difference of longitude.

Fiftly, by the rumbe, distance, and one latitude, you may finde the other latitude and the difference of longitude after this manner: Take the distance giuen with the Compasses in the æquinoctiall: set one foote in the concurse of the rumbes, and with the other crosse the rumbe giuen: from this crossing draw a perpendicular to the æquinoctiall: the length of that perpendicular taken with the Compasses and brought into the æquinoctial, shall shew you the difference of latitude. Thus hauing both latitudes giuen, the difference of longitude may also be found as before, Prob. 2.

Now in euery one of these problemes there may be some particular cases whereof some diuersitie of working may arise, yet such as can breed but small trouble to him that well doth conceiue the reason of that is alreadie set downe in these fiue former Problemes: which are especially to bee applied to such places as are both on ỹ same side of the æquinoctial, and differ also both in longitude and latitude: of which sort is the greatest number, and in which the greatest vse, and most difficultie of working consisteth. To prosecute euery particularitie at large (whereof some perhaps lesse acquainted with the reason of these Mathematicall practises may be desirous) would bee now for mee too long and tedious. For some taste therefore of the vse of this nauticall planisphære, let thus much for this time briefly suffice.

CHAP.

Chap. XIII.

Error in the vſe of the Compaſſe, by the variation neglected, and how to obſerue and auoid the ſame.

NExt the Sea-chart there is not any inſtrument of Nauigation whereby greater error may enſue then by the Compaſſe, if the variation bee neglected. By which neglect alone wee may often times miſſe an whole point and more, in directing the courſe from place to place. Notwithſtanding, M. *Peter* of *Medina* laboureth greatly to proue that there is no variation of the Compaſſe, and that many inconueniences and abſurdities muſt needes follow out of that opinion (as hee eſteemeth it) thinking it to haue no better ground then the groſſe and erroneous obſeruations of vnskilfull Mariners, as by the third Chapter of his ſixt booke of the Art of Nauigation may appeare more at large. But daily experience (by many and diligent obſeruations, with exact inſtruments, heedfully vſed by skilfull obſeruers, not only at ſea, the vnconſtancie whereof (which cauſeth the ſhip to be alwaies vnſteadie) might giue ſome colour to M. *Peters* conceit of no variation: but alſo on firme land, where moſt ſteadie and certaine obſeruation may eaſily be made:) I ſay daily experience hath ſo often, ſo conſtantly, ſo manifeſtly proued this varying propertie to be in the Compaſſe, that it cannot by any meanes with reaſon be denied.

Now then for the better finding of this variation there muſt be conceiued two meridians; a true median

ridian, and a magneticall meridian: alſo a true azimuth, and a magneticall azimuth of the Sunne.

The true meridian is an azimuth paſſing by the poles of the world.

The magneticall meridian is an azimuth that paſſeth by the points of the wires in the compaſſe, or of the needle touched with the loadſtone.

The true azimuth of the Sunne is ſhewed by the arch of the horizon contained betwixt the azimuth of the Sunne, and the true meridian.

The magneticall azimuth of the Sunne is ſhewed by the arch of the horizon contained betweene the magneticall meridian & the azimuth of the Sun.

The difference of theſe two arks of the horizon is alwaies equall to the variation of the Compaſſe.

To find out the magnetical azimuth of the Sun, we muſt firſt know vpon what point of the Compaſſe the Sun is: which although it may be done by aime very neere the truth by him that is experiēced, eſpecially when the Sun is low, or at the horizon, riſing or ſetting: yet it may better be done with helpe of ſuch a ruler and ſights, as land-meaſurers vſe with their plaine tables, wherewith you may thus finde vpon what point of the Compaſſe the Sun is: Lay the edge of the ruler right ouer the center of the Compaſſe: then holding the ruler ſo fixed, and the Compaſſe-leuell ſo neere as you can aime, turne it about vntill the midſt of the Sun-beames paſſing through one of the ſights, fall alongſt vpon the edge of the ruler, or midſt of the oppoſite ſight. Then holding your eye in ſuch ſort ouer the Compaſſe, that the rulers edge may lie right vpon the center of the

flie,

flie, looke alſo vpon what point of the compaſſe the edge of the ruler lieth to the Sun-wards, for that is the point whereupon the Sun is at that time: which for breuities ſake may be called the Sunnes point. This point you ſhall look in the inſtrument following, and it ſhall ſhew you amongſt the degrees the magneticall azimuth of the Sun. As for example, when the Sun is due Eaſt by the compaſſe, I would know in what magneticall azimuth he is: Therfore I look the Eaſt point in this Inſtrument, which directeth me to 84 degr. $\frac{1}{2}$, which is the magneticall azimuth deſired. And the difference betwixt this and the true azimuth of the Sun is the variation of the compaſſe which we ſeek for. This difference therefore ſhall thus be found out: At the ſame time whē you obſerue the Sunnes point, let the height of the Sun be alſo obſerued. It is beſt to take both theſe obſeruations about the midſt of the forenoone, or afternoone, for then the height of the Sunne altereth quickly, and the refraction and parallax cannot much deceiue you, therefore at that time the true azimuth of the Sunne ſhall eaſily be knowne thus: Firſt finde out the declination of the Sun, remembring alwaies to giue allowance, or take away (according as the declination increaſeth or decreaſeth) for the place and time of your obſeruation: Then ſet your Aſtrolabe to the latitude of the place where you obſerue, and follow the parallel of the Suns declination, vntill you come to the almicantarath or height of the Sun knowne by obſeruation: for the azimuth that paſſeth by their mutuall interſection, is the true azimuth of the Sunne that was ſought for:

which

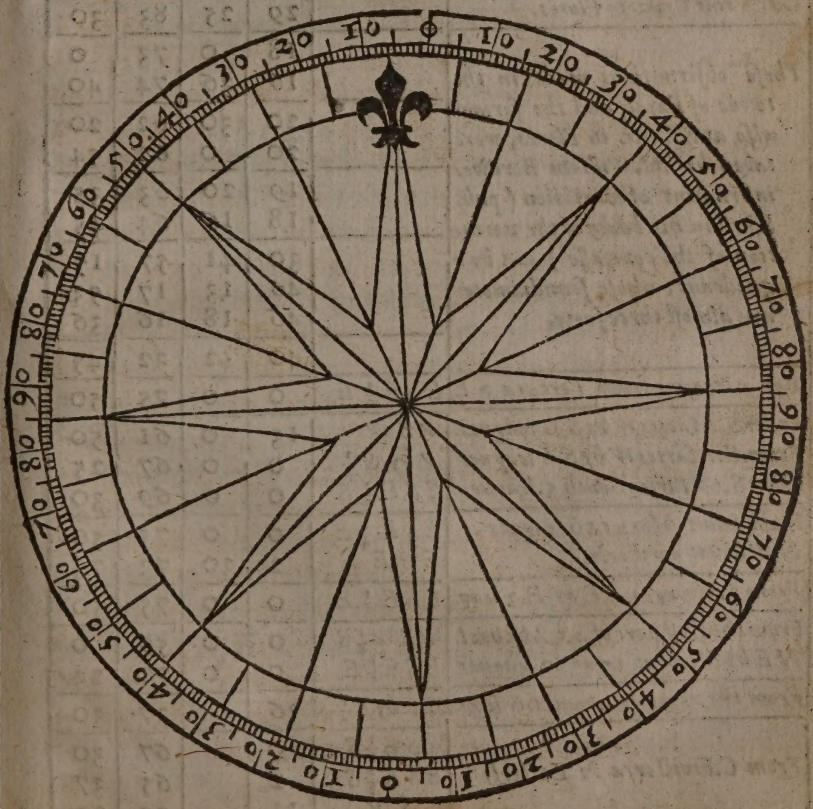
which if you follow down to the horizon, you ſhall haue that azimuth giuen. Now of theſe two giuen azimuths (that is, the true and magnetical azimuth of the Sun) ſubtract the leſſer from the greater, for the difference remaining is the variatiõ of the compaſſe: the denomination whereof (that is, whether it be Eaſterly or Weſterly) ſhall eaſily be diſcerned thus: If the true azimuth of the Sun counted from the South point in the forenoone, be leſſe then the magneticall azimuth, the variation is Eaſterly: otherwiſe it is Weſterly. Contrariwiſe, in the afternoone: if the true azimuth of the Sunne be greater then the magneticall azimuth, the variation of the Compaſſe from the point of true North is Eaſtwards, otherwiſe it is Weſtwards. And for the better vnderſtanding of theſe rules, I haue in the table following exemplified them by ſuch obſeruations, as I tooke both at Sea and land, in the yeere 1589.

The inſtrument following is then to be vſed whẽ obſeruation is made, as before hath bin ſhewed, by a Compaſſe, wherein the North points of the wires are ſet half a point to the Eaſtwards from the North point of the Compaſſe (of which ſort are the Compaſſes that are commonly vſed by Engliſh mariners) whereas if the points of the wires were ſet iuſt vnder the points of North and South: and the circumference of the Compaſſe diuided into degrees both Eaſtwards and Weſtwards, beginning at the North and South points, and ending with 90 at Eaſt and Weſt: wee might at the firſt haue the magneticall azimuth of the Sunne by obſeruation, and ſo there ſhould be no need of this inſtrument.

In

In the table here following the letters N, W, S, E, b, in the firſt & ſecond columnes, ſignifie North, Weſt, South, East, by. The fractions in the ſecond columne are parts of the point whereto they are annexed. In the columne intituled, The time of obſeruation, the letters B N, and A N ſignifie, before noone, and after noone.

An Inſtrument for the readie finding of the Suns magneticall azimuth by the ordinary Compaſſe.



The place of obseruation.	The Sunnes point of the Compasse.	The height of the sunne		The Sunnes magneticall azimuth.	
		Deg.	Min.	Deg.	Min.
About twenty leag. from Spaine W	$\nu NW\frac{1}{3}N$	0	0	69	30
30 or 40 leagues from Spaine W.	$ENE\frac{1}{2}E$	0	0	56	15
About the midway betwixt Lisbon and Saint Michaels.	ENE	0	0	61	40
	WNW	0	0	73	7
Betwixt S. Michaels and Tercæra.	E by $N\frac{1}{2}N$	2	0	70	52
About 3. leag. from Tercæra S S W	E by $N\frac{1}{4}N$	2	30	70	53
At Saint Cruz in Flores.		29	25	83	30
These obseruations made in the towne of Fayal, and the former also at S. Cruz in Flores, were taken by M. William Borowes instrument of variation (published in his booke of the variation of the compasse) and by a quadrant, whose semidiameter was almost three foote.		18	0	73	0
		16	36	74	40
		20	30	62	20
		20	0	62	54
		19	20	63	35
		18	16	64	45
		30	41	57	15
		46	13	17	53
		46	18	16	36
		40	42	32	45
3 or 4 leagues from Tercæra S E	$ESE\frac{1}{4}E$	0	0	75	50
From S. Maries W by S 6 leagues.	νSW	13	0	61	50
From S. Maries W by S 6 leagues	W by $S\frac{1}{2}S$	0	0	67	25
From S. Maries South 5. leagues	$ESE\frac{1}{2}S$	0	0	69	30
From Saint Maries 16 leagues	$ESE\frac{1}{4}E$	0	0	75	50
NW by W northerly.	ESE	2	30	73	$7\frac{1}{2}$
From S. Georges S E by E 3 leag.	$ESE\frac{1}{4}E$	0	0	75	50
From the East part of S. Michael.	$WSW\frac{1}{4}S$	0	0	59	0
NE by N, about 15 or 20 leagues	$ESE\frac{1}{4}E$	0	0	70	23
From the rocke W about 66 leag.	SE by $S\frac{1}{6}S$	26		37	30
From C. Finisterra N Easterly	$ESE\frac{1}{2}S$	0		67	30
	$ESE\frac{2}{3}S$	2		65	37
	SW	11		39	22

The time of observation.		The latitude of the place observ.		The declination of the Sunne.		The true azimuth of Sunne.		The variation of the Compasse.		The middle variation.		The part of variation.
		De.	Mi.	De.	Mi.	De.	Mi.	De.	Mi.	Deg.	Min.	
Iul. 9	A N	39	50	20	53	62	0	7	30			Eastward
12	B N	39	0	20	25	63	20	6	45			Eastward
23	B N	38	0	17	55	67	0	5	20	5	38	Eastward
23	A N	38	0	17	46	67	10	5	57			Eastward
Aug. 8	B N	38	20	13	13	74	10	3	18			Eastward
9	B N	38	20	12	54	75	0	4	7			Eastward
14	A N	39	50	11	5	79	30	4	0			Westward
Se. 13	A N	38	54	0	8	74	35	1	35			Eastward
13	A N	38	54	0	9	76	0	1	20			Eastward
22	A N	38	54	3	39	67	10	4	50			Eastward
22	A N	38	54	3	39	67	30	4	36			Eastward
22	A N	38	54	3	30	68	15	4	40	3	5	Eastward
22	A N	38	54	3	40	69	20	4	35			Eastward
23	B N	38	54	3	53	54	20	2	55			Eastward
23	B N	38	54	3	54	14	0	3	53			Eastward
23	B N	38	54	3	54	13	30	3	6			Eastward
23	A N	38	54	4	0	35	15	2	30			Eastward
Oc. 18	B N	38	20	13	5	73	0	2	5			Eastward
23	A N	37	0	14	50	60	0	1	50			Westward
23	A N	37	0	14	51	71	5	3	40	0	55	Eastward
24	B N	37	0	15	2	70	50	3	20			Westward
26	B N	37	30	15	38	69	50	6	0	5	34	Eastward
26	B N	37	30	15	39	68	0	5	7			Eastward
28	B N	38	40	16	16	68	45	7	5			Eastward
No. 1	A N	38	40	17	30	67	10	8	10			Eastward
2	B N	38	40	17	41	66	50	3	33			Eastward
6	B N	38	35	18	43	31	0	6	30			Eastward
12	B N	44	25	20	5	61	0	6	30			Eastward
12	B N	44	25	20	5	58	0	7	37	7	4	Eastward
12	A N	44	30	20	11	46	15	6	52			Eastward

Notwithſtanding there bee much difference betwixt ſome of theſe variations takē at the ſame place with the ſame inſtruments, yet wee vſed with what diligence wee could ſuch inſtruments as then wee had prepared for that purpoſe: which I ſpeake, that others that ſhall goe about hereafter to obſerue the variation (at ſea eſpecially) may be the more circumſpect to foreſee and preuent all cauſes of error herein. Exact truth amongſt the vnconſtant waues of the ſea is not to bee looked for, though good inſtruments be neuer ſo well applied to their vſe. Yet with heedfull diligence we may come ſo neere the truth, as the nature of the ſea and of our ſight and inſtruments will giue vs leaue. Neither if there bee ſome diſagreement betwixt obſeruations, are they all by and by to bereiected. But as when many arrowes are ſhot at a marke, and the marke afterwards taken away, he may be thought to worke according to reaſon, who to finde the place where the marke ſtood, ſhall ſeeke out the middle place amongſt all the arrowes: ſo amongſt many different obſeruations, the middlemoſt is likeſt to come neereſt the truth.

Cauſes of error herein, ſome cannot be auoided, as the vnſteadineſſe of the ſhip, the imperfection of ſenſe and inſtruments, the weake reſpectiue force of the needle or wires, be they neuer ſo well touched. Others may be eſchued, as that there bee no iron neere the Compaſſe in time of obſeruation, that the wires be kept cleane from ruſt, and that they be not kept too long vntouched from the ſtone, that ſuch inſtruments be vſed for obſeruation as need leaſt working afterwards for finding out the variation.

tion: wherein the inſtruments heretofore publiſhed for this purpoſe, are faultie, being ſuch as ſerue for obſeruation onely on land: as alſo requiring many workings afterwards, vnfit for Mariners, before the matter can come to iſſue, wherein are as many lurking holes of error without great diligence. I haue therefore heere ſet downe the making and vſe of a certaine inſtrument, whereby the variation of the Compaſſe and time of the day is preſently giuen, together with the obſeruation (the latitude of the place being knowne) and ẏ vniuerſally throughout the world, both at ſea and land. As alſo the variation being giuen, the height of the pole, and houre of the day may thereby be knowne, without thoſe inconueniences, wherewith *Martin Corteſe* his inſtrument, Chap. 11. part 3. of the Art of Nauigation, and *Michael Coignet* his nautical hemiſphere, are much incumbred: to omit the obſeruation of the height of the Sunne, which (as I haue oft made triall at ſea) may thereby bee more exactly performed, then hath been hitherto by ſtaffe, ring, or aſtrolabe, as they are commonly vſed.

The making of the Sea-rings.

MAke foure rings of equal thicknes and breadth conuenient, ſo as they may not eaſily bend: let them be fitted that each of them may goe cloſe within other. The two greateſt of theſe rings muſt be ſo made and framed together, that the innermoſt may ſlide about within the vttermoſt, both ſides agreeing alwaies, euen together in one and the ſame plaine ſuperficies. Within the innermoſt of theſe

two rings muſt the third ring be hanged vpon two round pins diametrally oppoſite each to other; ſo as vpon thē it may be turned aſide, till it make right angles with the former. Againe, within this third ring muſt the fourth be hanged likewiſe vpon two pins diametrally oppoſite 90 degr. diſtant from the former pins. The vppermoſt ring repreſenteth the meridian fixed: the next within it repreſenteth a meridian moueable: the third ſignifieth the æquinoctial or parallel of the Sun: the fourth, the circle paſſing by the points of Eaſt and Weſt, and by the poles of the world. Vpon one of the ſides of the innermoſt and moueable meridian (90 degrees from the pins whereupon the æquinoctiall ring hangeth) muſt be fixed an index or pointer, the point whereof may reach vnto the midſt of the conuexitie of the innermoſt circle, into a little hole, diſtant from the middle point betweene the pinnes or poles whereupon it hangeth, ſo much as halfe the thicknes of that circle commeth to, ſo as the point of that index being put into this hole, the meridian and the inner circles may croſſe each other preciſely at right angles. Nintie degrees from the pinnes or poles of this innermoſt ring, through the midſt of the concauitie and conuexitie thereof, muſt two ſmall holes be made; and a threed ſtretched ſtraight betwixt them (repreſenting the axtree of the world) with a ſmall beade (about the bigneſſe of a pinnes head) put here vpon, repreſenting the center of the earth. Let the vpper halfe of the vppermoſt and fixed meridian be diuided into 180 degrees, ſetting figures to euery tenth or fifth degree, beginning at either end, and ending

The figure of the Sea-rings.

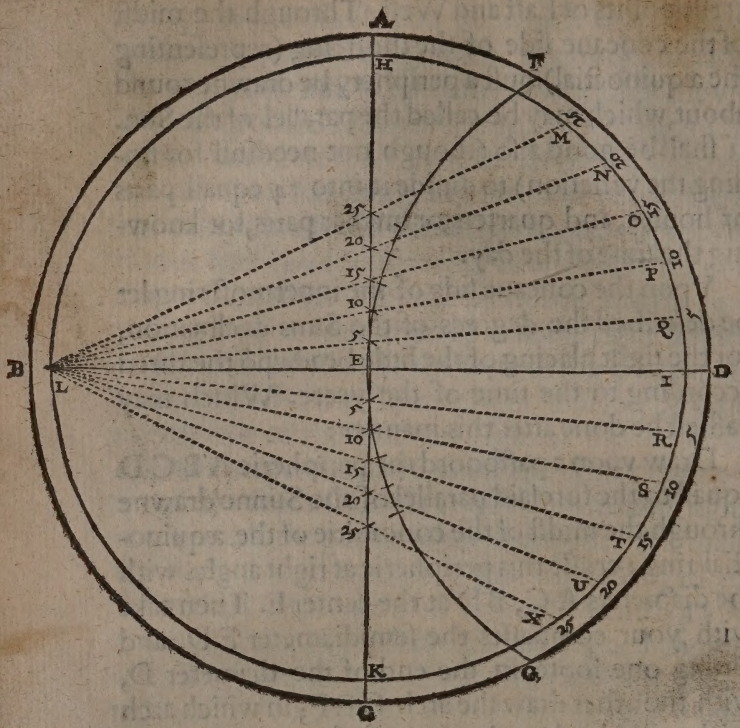
ending in the midst with 90, which representeth the zenith: where a ring must be set thereto, to hang the whole instrument by, as the manner is in the vse of the Astrolabe. Diametrally opposite to the midst of this semicircle there must be fastned to the conuexitie of this fixed meridian the foote peece of this instrument, made of some such fashion and proportion as here you see, agreeing in one and the same plaine superficies with the meridian, and the line passing by the feete thereof making right angles with the zenith line. To the feete of this peece must be annexed the Sea Compasse, in such sort that the zenith line of the graduated side of the meridian may fall perpendicularly vpon the center thereof, the plaine superficies of the meridian making right angles with the plaine of the compasse. All these circles, and compasse being thus ioyned together, the whole instrument must be rectified and equally counterpoized by the help of a plumbline hanging on a small pinne at the zenith point directly vnder the ring, that hanging the instrument by the ring (like an Astrolabe) the plumbline may fall precisely vpon the nadir point of the fixed meridian, scarcely touching the same: for so the instruments owne weight, hanging it onely by the ring (like an Astrolabe) shall make it hang exactly perpendicular, whē-soeuer you vse it. Let the points of the wires in the compasse be placed iust vpon the points of North and South in the flie; the circumference whereof must be diuided into degrees, beginning at those points, and from thence proceeding both waies, set figures at euery fifth or tēth degree, ending with 90

at

at the points of East and West. Through the midſt of the concaue ſide of the third ring (repreſenting the æquinoctial) muſt a periphery be drawne round about, which may be called the parallel of the Sun. It ſhall be good alſo (though not needfull for finding the variation) to diuide it into 24 equall parts or houres, and quarters, or ſmaller parts, for knowing the time of the day.

Vpon the concaue ſide of the innermoſt ring let be deſcribed the degrees of the Suns declination, for the right placing of the little bead vpō the thred according to the time of the yeere. Which may eaſlieſt be done after this manner:

Draw vpon a paſtboord the peripherie A B C D equall to the foreſaid parallel of the Sunne drawne through the midſt of the concauitie of the æquinoctial ring: croſſe this peripherie at right angles with the diameters A C, B D at the center E. Then take with your compaſſes the ſemidiameter E D, and ſetting one foote in the end of the diameter D, with the other draw the arch G E F; in which arch pricke out both waies from E ſo many degrees, as the Sunnes greateſt declination amounteth vnto: and laying your ruler to D, and to euery one of thoſe degrees; croſſe the diameter A C with ſhort ſtrokes, as you ſee in this diagramme, and laying the ruler to euery one of thoſe croſſes and the pricke at B, make prickes by the ſide of the ruler in the innermoſt peripherie H I K L, which muſt be equall to the concauitie of the innermoſt ring of the inſtrument: And then laying the concauitie and quarters of that ring iuſtly agreeable with



this peripherie, and the ends of the diameters thereof (the thred vpon which the little beade rideth) lying right ouer the diameter H K, you may with a ſharpe point of ſteele ſtrike vp the ſaid pricks made in the innermoſt peripherie into the concauitie of the innermoſt ring, and to euery fifth or tenth degree ſet figures as the manner is. There muſt alſo be made in the ſaid innermoſt ring a point anſwerable to the point at B in this former figure, in which point there muſt bee faſtned a ſmall ſtump ſtanding vpright

vpright from the ſide of that ring about the height of a pinnes head. By meanes whereof and the degrees of the Sunnes declination (proiected, as wee haue ſhewed, into the concauitie of the innermoſt ring) the little beade muſt be right placed vpon the thred, by bringing it into a ſtraight line betweene that ſtump and the Sunnes declination anſwerable to the time of your obſeruation: which may bee done by laying the edge of a ſtraight ruler, or a ſmall thred ſtretched from that ſtump, to the degree and part of the Sunnes declination, and then bringing the midſt of the bead vnder that edge or thred: Or elſe by ſight only, with one of your eyes, laying the top of that ſtump vpon the Sunnes declination, and then bringing the bead betweene; ſo as you may ſee them all three in one ſtraight line.

The bead being thus rightly placed, put aſide the æquinoctiall ring from the braſſe pointer (repreſenting the pole artick) that it may croſſe the meridian at right angles, which it ſhal preciſely do, if you bring the prick or little hole, vpō the outſide of the innermoſt circle to the end of the foreſaid braſſe pointer, ſo as the end thereof may enter thereinto. Then ſet the line that is drawne from the end of the braſſe pointer, to the eleuation of the pole at the place of your obſeruation, and ſo haue you all parts of your inſtrument rightly placed for obſeruation.

Now when you will make obſeruation with this inſtrument, hang the ſame by his ring vpon your finger, as you doe when you obſerue the height of the

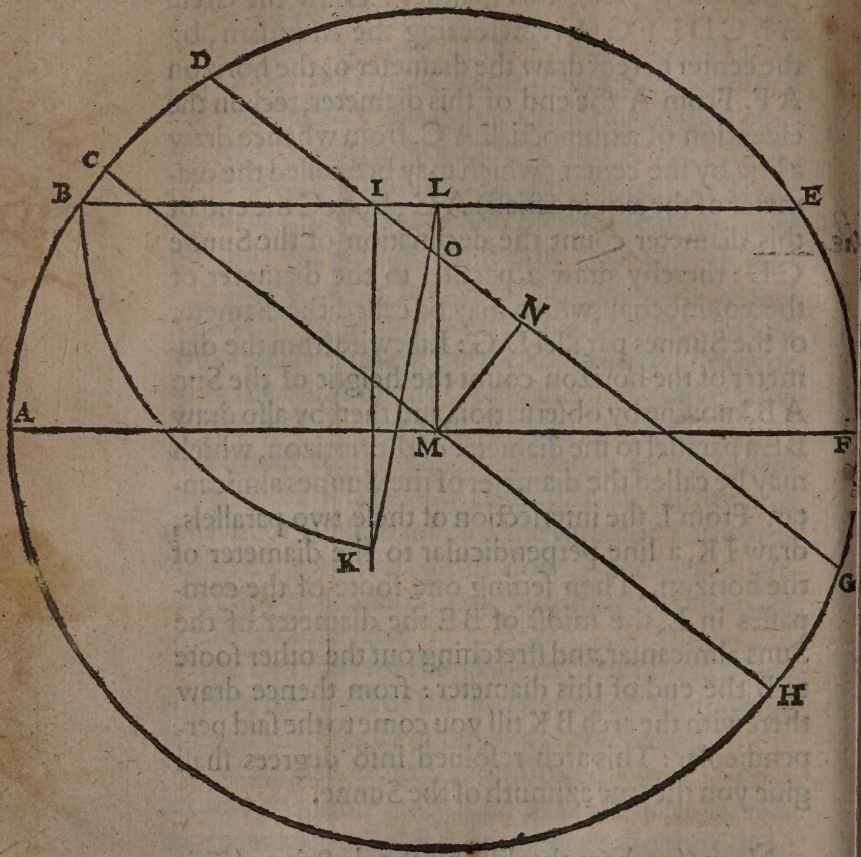
The vſe of this inſtrument.

the Sunne with the Astrolabe; turning the foresaid brasse pointer Northwards, till you finde the midst of the shadow of the beade to fall vpon the peripherie drawne round about through the midst of the concauitie of the æquinoctiall ring, which peripherie wee called the parallel of the Sunne: and so keepe the whole instrument and compasse as steady as you can, till the flie of the compasse remaine quiet and still; keeping in the meane time the midst of the shadow of the beade alwaies vpon the foresaid parallel of the Sunne; and withall looking close by the graduated side of the meridian directly downe vpon the midst of the Compasse, and marke what degree and minute you see close thereby in the North part of the flie: for so much as the North point of the needle or wiers is from thence towards the East or West, so much is the variation Eastwards or Westwards. And the shadow of the beade lighting vpon the parallel of the Sun sheweth the houre and time of the day.

The best time for the taking of these obseruations is about the midst of the forenoone or afternoone, because that about those times the height of the Sunne altereth quickly, and his refraction also can breed no sensible error. But because there be many that want both this instrument, & also the Globe and Astrolabe before mentioned, I haue for their sakes thought it good to set downe a way whereby (the declination and height of the Sun being giuen, together with the latitude of the place) the Sunnes true azimuth may bee found with ruler and compasses.

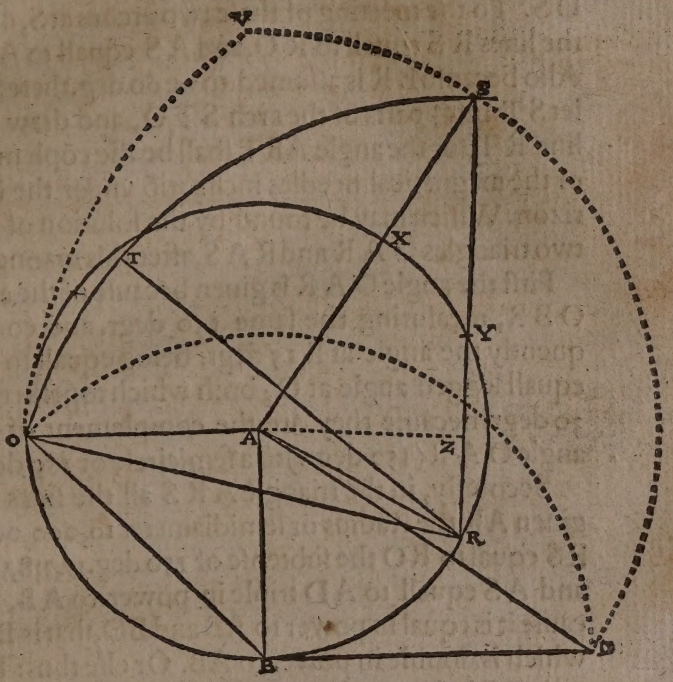
paſſes onely, after this manner: Draw the circle A B C D E F G H, repreſenting the Meridian, by the center hereof draw the diameter of the horizon A F. From A the end of this diameter, reckon the eleuation of æquinoctiall A C, from whence draw a line by the center (which may bee called the diameter of the æquinoctiall) A C; from C the end of this diameter count the declination of the Sunne C D: thereby draw a parallel to the diameter of the æquinoctiall, which may be called the diameter of the Sunnes parallel D G: Likewiſe from the diameter of the horizon count the height of the Sun A B, knowne by obſeruation, and thereby alſo draw B E a parallel to the diameter of the horizon, which may be called the diameter of the Sunnes almicantar. From I, the interſection of theſe two parallels, draw I K, a line perpendicular to the diameter of the horizon. Then ſetting one foote of the compaſſes in L, the midſt of B E the diameter of the Suns almicantar, and ſtretching out the other foote to B the end of this diameter: from thence draw therewith the arch B K till you come to the ſaid perpendicular: This arch reſolued into degrees ſhall giue you the true azimuth of the Sunne.

Now (for them that liſt) by the doctrine of Triangles alſo, M N (the ſine of the Sunnes declination) being giuen, with the angle M O N (equall to the height of the pole) in the right angled Triangle, O N M: the ſide O M ſhall likewiſe bee giuen: which ſubtracted out of M O L (the ſine of the Sunnes



Sunnes height) there remaine L O, whereby L I, in the Triangle L I O, hauing one right angle at L, and consequently I L K the angle desired, are giuen.

CHAP.



Chap. XIIII.

To finde the inclination or dipping of the magneticall needle vnder the Horizon.

LEt O B R be a meridian of the earth, wherein let O be the pole, B the æquinoctial, R the latitude (ſuppoſe 60 degrees) let B D be perpendicular to A B in B, and equall to the ſubtenſe O B; and drawing the line A D, deſcribe therwith the arch D S V. Then draw the ſubtenſe O R, wherewith

wherewith (taking R for the center) draw the arch O S. To the meeting of these two arches at S, draw the lines R S equall to R O, and A S equall to A D. Also becausse B R is assumed to be 60 deg. therefore let S T be $\frac{60}{90}$ parts of the arch S T O, and draw the line R T, for the angle A R T shall be the cõplement of the magnetical needles inclinatiõ vnder the Horizon. Which may be found by the solution of the two triangles O A R and R A S, after this manner:

First the angle O A R is giuen becausse of the arch O B R, measuring the same 150 degr. and consequently the angle at R 15 degr. being equall to the equall legged angle at O; both which together are 30 degr. becausse they are the complement of the angle O A R (150 degr.) to a semicircle or 180 degr.

Secondly, in the triangle A R S all the sides are giuen A R the Radius or semidiameter 10,000,000: R S equal to R O the subtense of 150 deg. 19,318,516: and A S equall to A D triple in power to A B, becausse it is equal in power to A B and B D, that is B O; which is double in power to A B. Or else thus: The arch O B being 90 degrees, the subtense therof O B, that is, the tangent B D is 14,142,136, which sought in the table of Tangents, shall giue you the angle B A D 54 degr. 44 min. 8 sec. the secant whereof is the line A D that is A S 17,320,508. Now then by 4 Axiom of the 2 booke of *Pitisc.* as the base or greatest side S R 19,318,516 is to ỹ summe of the other two sides S A and A R 27,320,508; so is the difference of them S X 7,320,508 to the segment of the greatest side S Y 10,352,762; which being taken out of S R 19,318,516, there remaineth Y R 8,965,754,

the

the halfe whereof R Z 4,482,877, is the ſine of the angle R A Z 26 degr. 38 min. 2 ſec. the complement whereof 63 degr. 21 min. 58. ſec. is the angle A R Z, which added to the angle A R O 15 degr. maketh the whole angle O R S, 78 degr. 21 min. 58 ſec. whereof $\frac{60}{90}$ make 52 degr. 14 min. 38 ſec. which taken out of A R Z 63 degr. 21 min. 58 ſec. there remaineth the angle T R A 11 deg. 7 min. 20 ſec. the cõplement whereof is the inclination ſought for 78. degrees, 52 minutes, 40 ſeconds.

A ſhorter way to calculate the table of magneticall inclination.

The ſumme and difference of the ſides S A and A R being alwaies the ſame, *viz.* 27,320,508 and 7,320,508, the product of them ſhall likewiſe be alwaies the ſame, *viz.* 199,999,997,378,064 to be diuided by ŷ ſide S R, that is R O the ſubtenſe of R B O. Therefore there may be ſome labour ſaued in making the table of magneticall inclination, if in ſtead of the ſaid product you take continually but ŷ halfe thereof, that is 99,999,998,689,032, and ſo diuide it by halfe the ſubtenſe R O, that is, by the ſine of halfe the arch O B R. Or rather thus: As halfe the baſe R S (that is, as the ſine of halfe the arch O B R) is to halfe the ſumme of the other two ſides S A & A R 13,660,254, ſo is half the difference of thẽ 3,660,254 to halfe of the ſegment S Y, which taken out of half the baſe, there remaineth R Z ŷ ſine of R A Z, whoſe cõplement to a quadrãt is ŷ angle ſought for A R Z.

According to this Diagramme and demonſtration was calculated the table here following; the firſt columne whereof conteineth the height of the pole for euery whole degree; the ſecond columne ſheweth the inclination or dipping of the magneticall needle anſwerable thereto in degr. and minutes.

The

First col.	Second col.		First col.	Second col.		First col.	Second col.	
Height of the Pole.	Magneticall inclination.		Heights of the Pole.	Magneticall inclination.		Heights of the Pole	Magneticall inclination.	
Degrees.	Degr	Min.	Degrees.	Degr.	Min.	Degrees	Degr.	Min.
1	2	11	31	52	27	61	79	29
2	4	20	32	53	41	62	80	4
3	6	27	33	54	53	63	80	38
4	8	31	34	56	4	64	81	11
5	10	34	35	57	13	65	81	43
6	12	34	36	58	21	66	82	13
7	14	32	37	59	28	67	82	43
8	16	28	38	60	33	68	83	12
9	18	22	39	61	37	69	83	40
10	20	14	40	62	39	70	84	7
11	22	4	41	63	40	71	84	32
12	24	52	42	64	39	72	84	57
13	25	38	43	65	38	73	85	21
14	27	22	44	66	35	74	85	44
15	29	4	45	67	30	75	86	7
16	30	45	46	68	24	76	86	28
17	32	24	47	69	17	77	86	48
18	34	0	48	70	9	78	87	8
19	35	36	49	70	59	79	87	26
20	37	9	50	71	48	80	87	44
21	38	41	51	72	36	81	88	1
22	40	11	52	73	23	82	88	17
23	41	39	53	74	8	83	88	33
24	43	6	54	74	52	84	88	47
25	44	30	55	75	35	85	89	1
26	45	54	56	76	17	86	89	14
27	47	15	57	76	57	87	89	27
28	48	36	58	77	37	88	89	39
29	49	54	59	78	15	89	89	50
30	51	11	60	78	53	90	90	0

Chap. XV.

Errors in vsing the Crosse-staffe, and how they may be auoided.

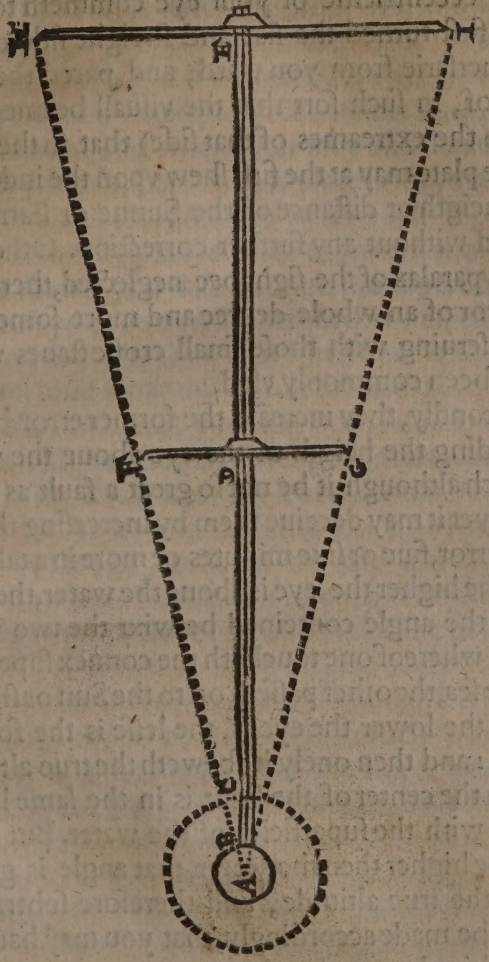
AFter the Chart and Compasse, the crosse staffe may with good reason succeed, as in the vse whereof more error is cõmitted, then in any other instrumẽt of Nauigation, the two former excepted, and that foure seuerall waies: First in neglecting the paralax or eccentricitie of the eye: Secondly, in not considering the height of the eye aboue the water: Thirdly and fourthly, in not regarding the paralax and refraction of the Sunne.

For the first, they count the height of the Sunne and Starres in such sort as if the center of the eye, or vertex of the visuall cone in vsing the Staffe, were euen with the end thereof that is set to the eye. Therefore how much the center of the sight is distant from the end of the Staffe, so much are they deceiued. But how much the eccentricitie or paralax of the eye is, it may be knowne after this manner: Make two transuersaries, the one twice so long as the other. The longest of these two set fast at the further end of the index, the other of them moue vp or downe vpon the index, vntill such time that your eye placed at the end of the index (in such sort as you vse to place it when you obserue) you may see both ends of both transuersaries lie euen together. For then looke how much the segment of the index betwixt the two transuersaries exceedeth the segment from the shorter transuersaries vnto the

eye, so much is the parallax or eccentricitie of your sight, or the point wherein your eye, wherein the visuall beames concurre, is so much distant from the end of the index.

As for example, in this figure let the transuersarie H E I placed at E the end of the index be double to the transuersarie F D G, which is placed in such sort vpon the index, that the visual lines (A F H, A G I) of the eye placed at the end of the index, do passe straight on by F H and G I, the ends of the transuersaries. For in this figure, A is the center of the sight or eye, wherein the visuall lines (A F H, A G I) doe concurre: B representeth the end of the index, placed at the corner of the eye, and then A B is the eccentricitie: C signifieth the end of the index set against the bone vnderneath the eye, for obseruing of distances, and then A C is the eccentricitie, which is thus demonstrated: *concurre*

As H E is to F D, so E D A to D A, 13. e 5. Ra. But H E is double to F D by suppositiõ: therfore E D A is double to D A, and D A the half of E D A equal to the other halfe D E. Therefore how much B D or C D is shorter then D E, so much is the paralax or eccentricitie of the eye, and so much must the transuersarie be remooued forwards (from the place where he was set in the time of your obseruation) towards the farre end of the index, after you haue obserued any heigth or distance of the Sunne or Starres, that so you may haue the true height or distance desired. Or else you may haue a plate of brasse so artificially fitted close within, by the side of the square hole in the transuersarie, through which the



the index is to be put, that you may slip it forwards or backwards like the couer of a boxe, and so set the fore-edge thereof so much before the transuersarie,

as the eccentricitie of your eye commeth to (hauing first turned the flat and streight side of the transuersarie from you ward, and pared the ends thereof, in such sort that the visuall beames may touch the extreames of that side) that so the edge of the plate may at the first shew vpon the index the true heigth or distance of the Sunne or starres obserued without any further correction. Otherwise if this paralax of the sight bee neglected, there may be error of an whole degree and more sometimes in obseruing with those small crosse staues which haue been commonly vsed.

Secondly, they increase the former error by not regarding the heigth of the eye aboue the water. Which although it be not so great a fault as the other, yet it may deceiue them by increasing the former error, fiue or sixe minutes or more in a tall ship. For the higher the eye is aboue the water, the greater is the angle conteined betwixt the two visuall lines, whereof one toucheth the conuex superficies of the sea, the other passeth on to the Sun or starres: And the lower the eye is, the lesse is the foresaid angle: and then onely it sheweth the true altitude, when the center of the sight is in the same line of leuell with the superficies of the water. But if the eye be higher then the water, that angle is greater then the true altitude, and therefore subtraction must be made accordingly, that you may haue the true altitude.

Now to finde how much it is that should be subtracted at any height of the eye aboue the water there be two waies; the one without knowledge of

the

the earths ſemidiameter, the other with knowledge of the ſame. For the firſt, you muſt haue ſome ſuch conuenient place at the water ſide where you may haue a free and cleere proſpect vnto the ſea without impediment, and where you may alſo haue ſuch prouiſion made, that you may place both your ſelfe, and alſo an exact and large water leuell in conuenient manner to make exact obſeruation at what height ſoeuer you deſire aboue the ſuperficies of the ſea, til you come to the height of the talleſt ſhips that goe vpon the ſeas: that leuell hauing the ſight that you muſt looke through at the end therof next the eye ſo fitted, that you may both eaſily and ſteadily ſet it higher then the foreſight (that is the ſight that is at the fore-end of the leuell) ſo much as ſhall be needfull to lay the foreſight preciſely to the touching of the ſea; and that you may alſo perfectly know how much the backſight, or ſight at your eye, is higher then the foreſight aboue the line of leuell: For by the difference of the heights of thoſe ſights aboue the line of leuell, and the diſtance betweene them, it may eaſily be found how much the viſuall line touching the roundnes of the ſea, dippeth vnder the line of leuell, or true Horizon, from whence the height of the ſunne and ſtarres is to be accounted, thus: As the diſtance betwixt the ſights is to the difference of their heights aboue the line of leuell; ſo is the whole ſine to the tangent of the angle of dipping, which we deſired to know.

This angle may otherwiſe be found, the quantitie of the earths ſemidiameter being firſt knowne, which is to be done diuers waies; but they may be

all reduced to two heads or kinds, whereof the first requireth the certaine measure of some arch of the meridian to be first giuen, which is also diuers waies to be performed. But the best and perfectest way of all others is to obserue so exactly as is possible the summer solstitiall altitude of the Sunne at two places, so farre distãt asunder, and lying so neere North and South each from other with so direct and faire a way betweene them as conueniently may be chosen. Suppose for example Portsmouth and Barwick, or some other place in the furthest parts of *Scotland*; for the further these places are each from other, the more perfectly may this businesse bee performed. Then measure, and plat down so truly as is possible, all the way betweene those two places, with all the turnings and windings, ascents and descents that are therein; out of which the arch of the great circle, or shortest distance betwixt them, together with the angle of declination thereof from the true meridian line truly found by obseruation at either of those places, may most exactly be knowne: whereby (with helpe of the doctrine of right angled sphæricall triangles) the difference of the latitudes of those two places in miles and furlongs &c. may easily appeare; which compared with the difference of the latitudes of the same places, found by obseruation of the Sun in degrees and minutes, &c. will shew how many miles and furlongs answer to one, or moe degrees of the meridian: and so the whole circumference, diameter, and semidiameter of the earth will easily, and more truly be found, then any other way yet vsed for this purpose. But meanes

A most exact way to finde the quantitie of the eaths semidiameter.

conuenient

conuenient for the triall hereof haue hitherto been wanting, and so I must omit it till some better opportunitie, if any shall befall hereafter by the bountie of any such as are of more abilitie to beare the charge hereof. Yet besides our purpose now in hand, this would bee the best ground that can be, both for the making and continuing of a standard, and all other measures thereon depending, at a certaintie for euer; insomuch that although all the standards, weights and measures in the world were lost, they might notwithstanding vpon record of such obseruation, and meanes, as here we haue mentioned, be againe restored much more perfectly, then by the ordinary way of beginning all our measures from a barly graine taken out of the midst of the eare, whereof there is no such certaine determinate bignesse that can be set downe, but that they may bee something greater in one eare then another; neither can there be any certaine rule or reason giuen how to know which eare to chuse rather then other, for this purpose. And if any error be committed herein, though insensible (which cannot be auoided) yet in going about to make other greater measures by often taking this least, and so proceeding *à minimis ad maxima*, so often as you take your first or least measure, so often doe you increase and multiplie your error: which though at the first it seeme very small and scarcely perceiuable, yet commeth at the last to be very notorious & intollerable. But the other way I here speake of, taking the length of all *England*, or of the whole Iland, for our first measure, and out of it by subdiuision, diuiding all

the reſt, although wee may erre ſomething in taking the length hereof (which notwithſtanding, I dare vndertake, may be ſo handled, that it ſhall not be ſo much as the thouſand part of the whole diſtance betweene the two places, before mentioned) yet becauſe we proceed *à maximis ad minima*, ſo ſtill diuiding, and the more diminiſhing this error, the further we proceed; it will in the end, when we come to our ordinarie meaſures moſt in vſe, become very inſenſible and not worth the regarding.

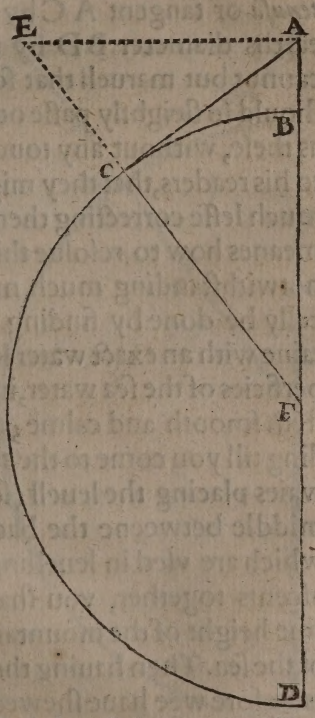
But to returne to our purpoſe from whence we haue a little digreſſed: The earths ſemidiameter may in like manner be found by obſeruation of the meridian altitudes of any notable fixed ſtarre at the two places before mentioned: but becauſe the heights of ſtars cannot by any meanes be ſo exactly obſerued as the height of the Sunne may be; the difference of the latitudes of the two places, and conſequently the perimeter (that is the circuite or compaſſe) and the diameter of the earth cannot be ſo perfectly found by this way as by the former.

As for that way which findeth the height of the Sunne and ſo the latitudes, by the length of the ſhadow of a ſtile or gnomon perpendicularly erected, it is like to be more vncertaine then either of the former, by reaſon of the ſcattering and vncertaine determining of the end of the ſhadow; beſide the knowledge of the Sunnes ſemidiameter hereunto required, which inconueniences may in the former waies be auoided.

The quantitie of the earths diameter is alſo to be found more eaſily, though not ſo exactly (without obſeruing

obseruing any height of sunne or starre, or measuring any arch of the meridian) by meanes of some great height giuen neere the sea side; as namely the height of some high mountaine, from whose top you may haue a free prospect so farre as you can see vpon the sea. Which *Maurolycus* endeuoureth to doe after this manner: *Clau. Comm. in 1. Cap. Ioan. de Sacrobosc.*

Let B C D be the circuit of ỹ earth A B the height of some high mountaine to bee found by the rules of measuring heights (But heere hee should haue done well to haue shewed vs by what rules; for the ordinarie rules will not serue the turne) A C a visual line from the top of the mountaine to C the point of the touching thereof with the sea or plain land where no hils are; (but such land wil very hardly be foũd that may serue for this purpose) C B the distance (without sensible error) of that point of touching from the perpendicular shewing the height of the mountaine; to be found also by the rules of measuring lengths so farre as we can see frõ the top of the mountain A.

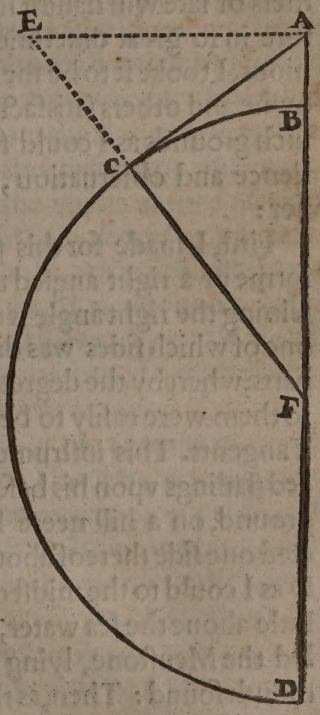


(But

Maurolycus and *Clauius* his grosse demonstration.

(But here also he should haue shewed some certain rule how to find both the point of touching C, and also the distance to it from B, and not so grossely to slubber ouer so nice a point as this is, in bidding vs measure so farre as we can see) Then rudely taking A B C for a plaine right angled triangle with the sides A B and B C found as before, we may without any further rubbe, proceed, and finde both the *hypotenusa* or tangent A C by the 47. 1 *Eucl.* as also the earths diameter B D by the 37. 3 *Eucl.* Yet here I cannot but maruell that so great a Clerke as *Clauius* should so sleightly passe ouer such grosse absurdities as these, without any touch or warning at all giuen to his readers, that they might not be abused by thē; much lesse correcting them, or shewing any better meanes how to resolue this probleme; which may notwithstanding much more easily and geometrically be done by finding the height of the mountaine with an exact water leuell, beginning at the superficies of the sea water, in some creeke where it resteth smooth and calme; and from thence proceeding till you come to the top of the mountaine, alwaies placing the leuell (so neere as may be) in the middle betweene the backmarke and foremarke, which are vsed in leuelling, and so adding all your ascents together, you shall haue very exactly the true height of the mountaine aboue the roundnesse of the sea. Then hauing the sights fitted in such sort, as before wee haue shewed, that you may raise the backsight (or sight at your eye) higher then ỹ foresight (at the farre end of the leuell) so much as shall bē needfull; place the leuell, so truly and steadily as you

you can, vpon the top of the mountaine; and so dispose the sight at your eye, that you may see the foresight lie euen with the touching of the sea, whereby the angle of depression or dipping of the visuall line vnder the line of leuell may be found by the difference of the heights of ỹ sights, as before is shewed. And then as the excesse of the secant of that angle aboue the whole sine, is to the whole sine: so is the height of the mountaine AB (already foũd) to the semidiameter of the earth, B F. For F C being continued to E and A E representing the line of leuell or true horizõ; EAC the angle of dipping shalbe equal to the angle A E C (by 16.3 and 8.6 *Eucl*) the secant whereof is A F; the whole sine BF (proportionall to the earths semidiameter) and the difference of them AB, proportionall to the height of ỹ mountaine.



But hauing not hitherto had meanes requisite to make triall of any of these waies alreadie mentioned, I haue thought of another way, whereby the height of the mountaine, and consequently the quantitie of the earths

semidiameter,

semidiameter may bee knowne; wherein because there is great varietie of opinions amongst the ancient and later writers, some making it to be almost 8000 miles; some little more thē 5500, some others not much exceeding 5000; others making it lesse then 3600; and others not much more then 3200, as *Alphraganus*, though *Fernelius*, according to his obseruation, findes it to bee 3900 miles, whereas others of late will haue it little more then 3000: therfore in so great diuersitie and vncertaintie of opinions, I tooke it to be the best course, both for mine owne and others satisfaction, to rest my selfe vpon such grounds as I could finde by mine owne experience and obseruation, and that after this manner:

First, I made for this purpose an instrument in forme of a right angled triangle, whose sides conteining the right angle were about sixe foote long; one of which sides was diuided into 10,000 equall parts, whereby the degrees and minutes answerable to them were easily to be found out of the table of Tangents. This instrument thus prepared and placed flatlings vpon his bases about three foote aboue ground, on a hill neere Plimmouth sound, I directed one side thereof about the right angle as exactly as I could to the midst of a small rock, appearing a little aboue the sea water, neere the great Rock called the Meustone, lying at the entrance of Plimmouth sound: Then, as the other side of the instrument about the right angle directed me, I tooke my second standing 664 foote by iust measure from the first; which distance was so much as the ground would

would well giue me leaue to take, for otherwise I would haue gone further. At this second station I found the angle conteined betweene the visuall lines directed to the first station and that small rock to be 87 degrees, 52 minutes; the tangent whereof is 26,845 such parts whereof the distance of the standing or whole sine conteineth 1000: whereby the distance from the first station to the said small rock was found to be 17,825 foote: for as 1000 to 26,845; so are 664 foote to 17,825 foote.

Then comming againe to the first station, and setting the Instrument steadie vpon edge, I first directed one of the sides about the right angle (lying neere the ground) to the said little rock; and then a plumbline hanging at the vpper corner of this Triangular Instrument, did fall 1 degree 14 minutes from the right angle forwards. After this I directed the same side, as truly as I could, to the very touching of the sphæricall superficies of the Sea; and then the plumbline fell 22 minutes from the same right angle forwards, towards the sea.

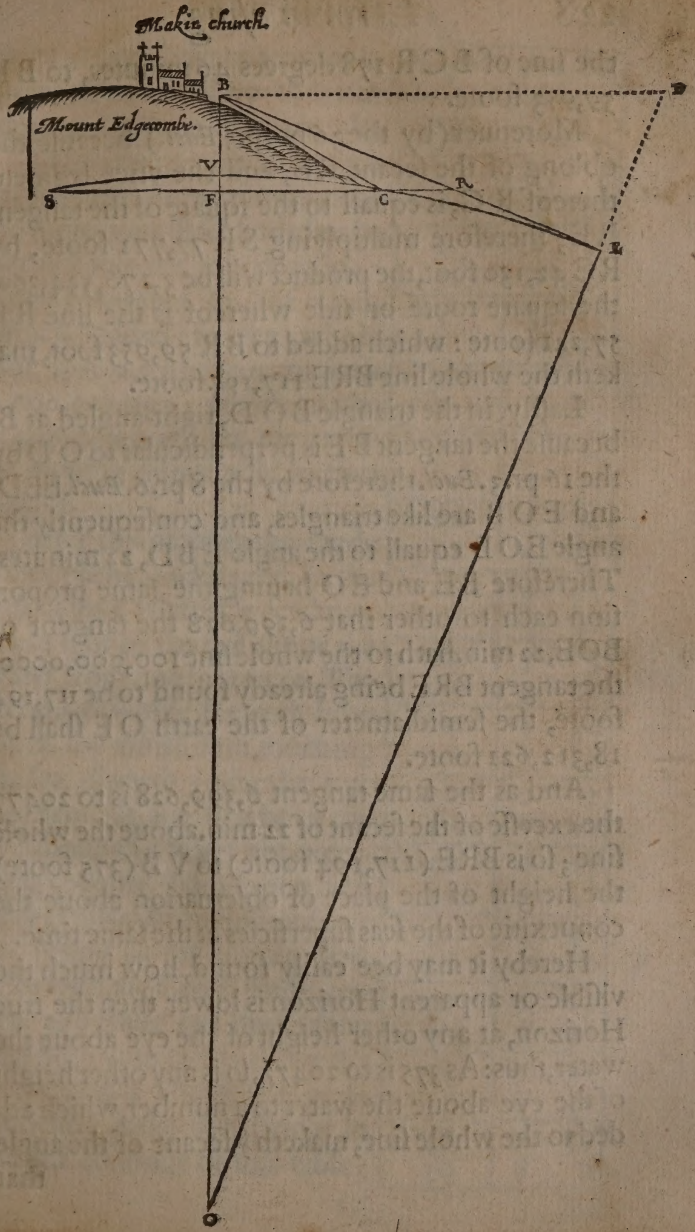
Out of these obseruations the semidiameter of the earth was found, thus: Let O be the center of the earth, S V C E the circumference of the sea: B the place of obseruation, B V F O a perpendicular line drawne from thence to the center of the earth: B D, the line of leuell or true Horizon: B C, the distance from the place of obseruation to the marke in the sea 17,825 foote: the angle C B D found by obseruation 1. degree 14 minutes: B R E a visuall line from the place of obseruation touching the sea: E, the point of touching: E B D, the angle betwixt that

that viſuall line and the line of leuell or true Horizon 22 minutes: R C F S, a parallel to B D, or line of leuell, drawne by the marke C: O F V, and O P, ſemidiameters of the ſeas circumference at the time of obſeruation: E D, the continuation of the ſemidiameter O E to the line of leuell or true Horizon B D.

Now in the triangle B C F, right-angled at F, the ſide B C being 17,825 foote, and the angle at B, 88 degrees 46 minutes (becauſe it is the complement of the angle C B D 1 degree 14 minutes) the ſide F C ſhall be 17,821 foote; which doubled maketh C F S 35,642 foote, and the angle at C (being the complement of the angle at B) is 1 degr. 14 minutes.

Then in the triangle B C R, the angle at C (being the complement of the angle B C F to a ſemicircle) is 178 degrees 46 minutes, and the angle at B (being the difference of the angles D B R 22 min. and D B C, 1 degr. 14 minutes) ſhall be 52 min. and conſequently the angle at R (the complement of the two former, to two right angles) 22 min. Now becauſe in all plaine triangles the ſides and ſines of the oppoſite angles are proportionall; therefore as 63,995 (the ſine of B R C 22 minutes, in ſuch parts whereof the whole ſine conteineth 10,000,000) is to B C 17,825 foote; ſo is 151,256 the ſine of C B R 52 min. to C R, 42,130 foot: which added to C F S 35,642 foote, giueth you the whole line R C F S, 77,772 foote.

Alſo in the ſame triangle as 63,995 the ſine of B R C 22 min. is to B C 17,825 foote; ſo is 215,241 the


Makin church.
B
Mount Edgecombe.
V
S
F
C
R
E
O

the sine of B C R 178 degrees 46 minutes, to B R 59,953 foote.

Moreouer (by the 36 prop. 3 *Eucl.*) because the oblong of the secant R S, and the vtter segment thereof R C, is equall to the square of the tangent R E; therefore multiplying S R 77,772 foote, by R C 42,130 foot, the product will be 3,276,534,360, the square roote or side whereof is the line R E 57,241 foote: which added to B R 59,953 foot, maketh the whole line B R E 117,194 foote.

Lastly, in the triangle B O D, right-angled at B, because the tangent B E is perpendicular to O D by the 16 pr. 3. *Eucl.* therefore by the 8 pr. 6. *Eucl.* E B D, and E O B are like triangles, and consequently the angle E O B equall to the angle E B D, 22 minutes. Therefore B E and E O hauing the same proportion each to other that 6,399,628 the tangent of B O E, 22 min. hath to the whole sine 100,000,0000, the tangent B R E being already found to be 117,194 foote, the semidiameter of the earth O E shall be 18,312,621 foote.

And as the same tangent 6,399,628 is to 20477 the excesse of the secant of 22 min. aboue the whole sine; so is B R E (117,194 foote) to V B (375 foote) the height of the place of obseruation aboue the conuexitie of the seas superficies at the same time.

Hereby it may bee easily found, how much the visible or apparent Horizon is lower then the true Horizon, at any other height of the eye aboue the water, thus: As 375 is to 20477, so is any other height of the eye aboue the water to a number, which added to the whole sine, maketh § secant of the angle

that

that sheweth how much the apparent Horizon dippeth vnder the true Horizon at that height.

As for example: if the height of your eye aboue the water be 20 foote, you shall finde by the former rule the fourth proportionall number to bee 1092, which added to the whole sine 1,000,000,000, maketh 1,000,001,092; which is the secant of 5 min. 5 sec. the angle of dipping answerable to that height.

After this manner was made this table here adioyned; in the first colũne wherof is set down the height of the eye aboue the water, from one foot to 50. The second columne sheweth how much the visuall line touching the sea, dippeth vnder the true Horizon, at any height of the eye aboue the water not exceeding 50 foote. The vse of which table is this: When you obserue the height of the sunne or stars at sea with the Crosse-staffe, you shall also finde out how many foot high your eye is aboue the water with a plumbline or otherwise: seeke that height in the first columne of this table;

Height of the eye.	*Angle of dipping.*	
Foote.	*Min.*	*Sec.*
1	1	8
2	1	36
3	1	58
4	2	16
5	2	33
6	2	47
7	3	0
8	3	13
9	3	24
10	3	35
12	3	56
14	4	15
16	4	33
18	4	50
20	5	5
22	5	20
24	5	34
26	5	48
28	6	1
30	6	13
32	6	25
34	6	38
36	6	49
38	7	0
40	7	11
42	7	21
44	7	32
46	7	42
48	7	52
50	8	2

and in the ſecond volume intituled *Angle of dipping*, you ſhall finde the number of minutes and ſeconds that are to be ſubtracted from the apparent height of the Sunne or Starres aboue the ſuperficies of the ſea, obſerued with the Staffe, that you may haue the apparent height aboue the true Horizon.

The third error hath place in taking the height of the Sunne or Moone with the Staffe, ring, quadrant, or Aſtrolabe, or any other inſtrument, whether by ſea or land: but in taking the height of the fixed ſtarres, this error is not to be regarded, being altogether inſenſible, by reaſon of their exceeding great diſtance from the earth, which is ſo much, that in compariſon thereof the ſemidiameter of the whole earth hath not any ſenſible proportion, and therefore the fixed Starres cannot haue any ſenſible paralax. But the Sunne by reaſon of his leſſer diſtance from the earth, hath a ſenſible paralax: in ſo much that in taking his height, wee may for this cauſe onely bee deceiued ſometimes about three minutes, by counting it leſſe then indeede it is, and that eſpecially in winter time, when the ſunne draweth neere the Horizon: which although it be no great error, yet it is not altogether to be neglected in the rules and grounds of Art, which ſo much as is poſſible ought to be without error.

For

For this cause I haue adioyned this table following of the Sunnes paralax: the vse whereof is this, in the first columne intituled the heigth of the Sunne, looke the Suns apparent heigth, and in the same line in the second columne, you shall haue the paralax of the sun, which alwaies is to be added to the apparent heigth, that so you may haue the true heigth of the sunne aboue the Horizon. As for example, admit I finde the apparent heigth of the sun to be 25 degrees, therefore I seeke that number in the first columne, and in the second columne I finde the paralax answerable thereto to be two minutes, 44 seconds, which added to 25 degrees, make the true height of the Sunne to be 25 degrees, two minutes, 44 sec.

The height of the Sun.	*The paralax of the Sunne.*	
Degr.	*Mi.*	*Sec.*
0	3	0
5	2	59
10	2	57
15	2	54
20	2	50
25	2	44
30	2	36
35	2	27
40	2	18
45	2	7
50	1	56
55	1	43
60	1	30
65	1	16
70	1	2
75	0	46
80	0	31
85	0	15

A fourth cause of error is the refraction of the beames of the sun or stars, which we obserue, by reason of the vaporous thicknesse of the ayre that is betwixt vs and them, especially when they are neare the Horizon. For the finding whereof; not hauing hitherto had sufficient meanes by mine owne obseruation for my full satisfaction herein: I haue there-

fore thought good to adioyne these tables of the Suns & fixed Starres refractions out of *Tycho Brahe*, which differ little frō such obseruatiōs as I haue made for triall hereof: the vse wherof is this: In the first columne seeke the altitude or height of the Sun or fixed Star, & in the second you shall haue the refraction answering thereto, which being subtracted out of the obserued height, you shal haue the height of the Sunne or Starre remaining, without refraction.

The Sunnes		*The Sunnes*		*The fixed Starres*	
Altitude.	*Refraction.*	*Altitude*	*Refraction.*	*Altitude.*	*Refraction.*
De.	*Mi. Se.*	*De.*	*Mi. Se*	*De.*	*Mi. Se.*
0	34 0	23	3 10	0	30 0
1	26 0	24	2 50	1	21 30
2	20 0	25	2 30	2	15 30
3	17 0	26	2 15	3	12 30
4	15 30	27	2 0	4	11 0
5	14 30	28	1 45	5	10 0
6	13 30	29	1 35	6	9 0
7	12 45	30	1 25	7	8 15
8	11 15	31	1 15	8	6 45
9	10 30	32	1 5	9	6 0
10	10 0	33	55	10	5 30
11	9 30	34	45	11	5 0
12	9 0	35	35	12	4 30
13	8 30	36	30	13	4 0
14	8 0	37	25	14	3 30
15	7 30	38	20	15	3 0
16	7 0	39	15	16	2 30
17	6 30	40	10	17	2 0
18	5 45	41	9	18	1 30
19	5 0	42	8	19	1 0
20	4 30	43	7	20	0 30
21	4 0	44	6	21	0 0
22	3 30	45	5		

Chap. XVI.

Faults amended in the Table of the Sunnes declination: commonly called the Regiment of the Sunne.

NOtwithstanding the Sunne and Starres are at sea the most certaine markes and guids the Nauigator hath, whereby he may direct himselfe to rectifie his course, and know where he is after many turnings, and trauersings this way and that way, especially in long voiages, wherein he may be forced many times by contrarie winds and calmes, to sing with the Poet for many weekes and monethes together.

Cœlum vndique & vndique pontus: and
Nihil est nisi pontus & æther:

Yet the Tables of declinations of the Sunne and fixed Starres hitherto published, which I haue compared together and examined by obseruation, are oft times very faultie: the declination of the Sunne in them set downe, being many times lesse then truth, by 10, 11, or 12 minutes, especially in the monethes of Februarie and March: and some of the principall fixed Starres that are of most vse in Nauigation, differing in declination from that is set downe in the

Tables more then one whole degree, as I haue found by many obſeruations.

For the eaſier mending of theſe faults in the Tables of the Sunnes declination, I thought it meete firſt to ſet downe the Table following, which ſheweth the declination of euery minute of the ecliptike in degrees, minutes, and ſeconds, whereby the place of the Sunne is preſently knowne, his declination being firſt giuen by obſeruation, and conſequently, his eccentricitie and apogęum were eaſily found, and the theoricke of the Sunne corrected: out of which the Ephemerides hereafter following, were calculated, ſhewing the true place of the Sunne for euery day of fiue yeares, agreeable, (without notable error) to the truth of the heauens: and out of theſe with helpe of this Table of declination, a new regiment (or table of the Sunnes declination, for euery day of fiue yeares) was moſt eaſily made: free from ſuch errors wherewith the tables hitherto publiſhed and commonly vſed, haue been too much peſtered: as by compariſon of this, and thoſe tables with the obſeruations hereafter following may euidently appeare.

CHAP.

Chap. XVII

Of the Table of declination of euery minute of the Ecliptick in degrees, minutes and seconds: Made according to the greatest obliquitte of the zodiak this present age; which by exact obseruation, is found to be 23 degrees 31 minutes and an halfe.

BEcause the table of declination heere following, doth differ something from the Tables heretofore published by others, whereof some make the greatest declination of the Sunne to be 23 degr. and 28 minutes only, as *Copernicus* and his followers (according to which the tables of declination and regiments of the Sunne, that haue been vsed for the most part by our English Mariners are made): whereas others of late, as that noble Astronomer *Tycho Brahe* in his second booke *De recentioribus ætherei mundi phænomenis*, findeth the same to bee by his obseruations 23 degr. 27 mi. pag. 38. 23 degr. 31 mi. pag. 386. 23 degr. 31 mi. 30 sec. pag. 217. (according to which there is a table of declination alreadie published by *Maginus*) and that excellent Geometrician *Regiomontanus* (whom *Petrus Nonius* compared by *Ramus* to *Archimedes* and *Clauius*, chose rather to follow) maketh it to be but 23 degr. 30 min. I thought it therefore needfull to shew what reasons moued

me to make choise of the greatest of all the declinations before recited, being thereunto induced, not only by the authoritie of that famous Astronomer of our time *Tycho Brahe:* but resting also vpon many and diligent obseruations of mine owne, (taken by a quadrant of more then sixe foot semidiameter, so exactly made and diuided into minutes and halfe minutes, as I could, and as heedfully vsed and truly rectified by a plumbline (euery time I obserued as my sight could discerne:) All which obseruations do proue with one consent, that the greatest declination of the Sunne in this our age, is 23 degrees, 31 minutes and an halfe; as thus it may appeare.

In the yeare 1594 the 11 and 12 daies of Iune, the apparent meridian altitude of the Sunne was obserued to be 61 degr. 58 min. whereto the obseruations of the 8, 9, 10, 13, 14 and 15 daies of the same moneth do well agree, wherein the apparent meridian altitudes of the Sunne, were 61 degr. 55 mi. ½ 61 degr. 56 mi. ½ 61 degr. 57 mi. 61 degr. 57 mi. ½ 61 degr. 57 mi. 61 degr. 56 mi. almost, as also the obseruations of the 9, 11, 12, and 13 daies of Iune, in the yeare 1597 in which daies the apparent meridian altitudes of the Sunne, were 61 degr. 57 mi. 61 degr. 58 ½ mi. almost, 61 degr. 58 mi. 61 degr. 57 mi. ½. By all which obseruations it may be certainly concluded, that the greatest apparent height of the Sunne here at London, is 61 degr. and 58 minutes.

Moreouer by many, and heedfull obseruations of the Pole-starre, taken about the yeare 1593 and 1594 I found the greatest height thereof at that time heere in London, to be 54 degrees, 24 minutes and an halfe,

halfe, and the least height 48 degr. 39 minutes ½ the differẽce of which heights is 5 degrees 45 minutes: the halfe whereof is 2 degrees 52 min. ½ that is, (the distance of the Pole-starre from the Pole) at that time added to the lowest height of the Pole-starre, sheweth the height of the Pole at *London*, to be 51 degrees, 32 minutes: the complement whereof (38 degrees, 28 minutes) is the height of the æquinoctiall, which subtracted out of the greatest apparent height of the sunne, 61 degrees 58 minutes: there remaineth the greatest apparent declination of the sunne, 23 degrees 30 minutes: whereto if we adde 1 minute, 22 seconds, that is the paralax of the sunne answerable to that height, we shall haue the greatest true height of the sunne, 61 degrees, 59 minutes, 22 seconds, and consequently the greatest true declination of the sunne for our time, 23 degrees, 31 minutes, 22 seconds, differing but halfe a quarter of one minute from the greatest declination finally determined and resoluedly set down by *Tycho Brahe* for this our age 23 degrees, 31 minutes and one halfe.

	Deg. 0			dif.	Deg. 1			dif.	Deg. 2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	0	0	0	24	0	23	57	24		47	53	24	60
1	0	0	24	24	0	24	21	24	0	48	17	24	59
2	0	0	48	24	0	24	45	24	0	48	41	24	58
3	0	1	12	24	0	25	9	24	0	49	5	24	57
4	0	1	36	24	0	25	33	24	0	49	29	24	56
5	0	2	0	24	0	25	57	24	0	49	53	24	55
6	0	2	24	24	0	26	21	23	0	50	17	24	54
7	0	2	48	24	0	26	44	24	0	50	41	24	53
8	0	3	12	24	0	27	8	24	0	51	5	24	52
9	0	3	36	24	0	27	32	24	0	51	29	24	51
10	0	4	0	23	0	27	56	24	0	51	53	24	50
11	0	4	23	24	0	28	20	24	0	52	17	24	49
12	0	4	47	24	0	28	44	24	0	52	41	24	48
13	0	5	11	24	0	29	8	24	0	53	5	23	47
14	0	5	35	24	0	29	32	24	0	53	28	24	46
15	0	5	59	24	0	29	56	24	0	53	52	24	45
16	0	6	23	24	0	30	20	24	0	54	16	24	44
17	0	6	47	24	0	30	44	24	0	54	40	24	43
18	0	7	11	24	0	31	8	24	0	55	4	24	42
19	0	7	35	24	0	31	32	24	0	55	28	24	41
20	0	7	59	24	0	31	56	24	0	55	52	24	40
21	0	8	23	24	0	32	20	24	0	56	16	24	39
22	0	8	47	24	0	32	44	24	0	56	40	24	38
23	0	9	11	24	0	33	8	24	0	57	4	24	37
24	0	9	35	24	0	33	32	23	0	57	28	24	36
25	0	9	59	24	0	33	55	24	0	57	52	24	35
26	0	10	23	24	0	34	19	24	0	58	16	24	34
27	0	10	47	21	0	34	43	24	0	58	40	24	33
28	0	11	11	24	0	35	7	24	0	59	4	23	32
29	0	11	35	23	0	35	31	24	0	59	27	24	31
30	0	11	58		0	35	55	24	0	59	51	24	30
		29				28				27			

	0 Deg	dif	1 Deg	dif.	2 Deg.	dif.	
mi.	Deg. Mi. Se	Se.	Deg. Mi. Se	Se.	Deg. Mi. Se.	Se.	mi.
30	0 11 58	24	0 35 55	24	0 59 51	24	30
31	0 12 22	24	0 36 19	24	1 0 15	24	29
32	0 12 46	24	0 36 43	24	1 0 39	24	28
33	0 13 10	24	0 37 7	24	1 1 3	24	27
34	0 13 34	24	0 37 31	24	1 1 27	24	26
35	0 13 58	24	0 37 55	24	1 1 51	24	25
36	0 14 22	24	0 38 19	24	1 2 15	24	24
37	0 14 46	24	0 38 43	24	1 2 39	24	23
38	0 15 10	24	0 39 7	24	1 3 3	24	22
39	0 15 34	24	0 39 31	24	1 3 27	24	21
40	0 15 58	24	0 39 55	24	1 3 51	24	20
41	0 16 22	24	0 40 19	23	1 4 15	24	19
42	0 16 46	24	0 40 42	24	1 4 39	23	18
43	0 17 10	24	0 41 6	24	1 5 2	24	17
44	0 17 34	24	0 41 30	24	1 5 26	24	16
45	0 17 58	24	0 41 54	24	1 5 50	24	15
46	0 18 22	24	0 42 18	24	1 6 14	24	14
47	0 18 46	24	0 42 42	24	1 6 38	24	13
48	0 19 10	23	0 43 6	24	1 7 2	24	12
49	0 19 33	24	0 43 30	24	1 7 26	24	11
50	0 19 57	24	0 43 54	24	1 7 50	24	10
51	0 20 21	24	0 44 18	24	1 8 14	24	9
52	0 20 45	24	0 44 42	24	1 8 38	24	8
53	0 21 9	24	0 45 6	24	1 9 2	24	7
54	0 21 33	24	0 45 30	24	1 9 26	24	6
55	0 21 57	24	0 45 54	24	1 9 50	23	5
56	0 22 21	24	0 46 18	24	1 10 13	24	4
57	0 22 45	24	0 46 42	24	1 10 37	24	3
58	0 23 9	24	0 47 6	23	1 11 1	24	2
59	0 23 33	24	0 47 29	24	1 11 25	24	1
60	0 23 57	24	0 47 53	24	1 11 49	24	0
	29		28		27		

	3 ♌			dif.	4 ♌			dif.	5 ♌			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	1	11	49	24	1	35	44	24	1	59	37	24	60
1	1	12	13	24	1	36	8	24	2	0	1	24	59
2	1	12	37	24	1	36	32	24	2	0	25	24	58
3	1	13	1	24	1	36	56	23	2	0	49	24	57
4	1	13	25	24	1	37	19	24	2	1	13	23	56
5	1	13	29	24	1	37	43	24	2	1	36	24	55
6	1	14	13	24	1	38	7	24	2	2	0	24	54
7	1	14	37	24	1	38	31	24	2	2	24	24	53
8	1	15	1	23	1	38	55	24	2	2	48	24	52
9	1	15	24	24	1	39	19	24	2	3	12	24	51
10	1	15	48	24	1	39	43	24	2	3	36	24	50
11	1	16	12	24	1	40	7	24	2	4	0	23	49
12	1	16	36	24	1	40	31	23	2	4	23	24	48
13	1	17	0	24	1	40	54	24	2	4	47	24	47
14	1	17	24	24	1	41	18	24	2	5	11	24	46
15	1	17	48	24	1	41	42	24	2	5	35	24	45
16	1	18	12	24	1	42	6	24	2	5	59	24	44
17	1	18	36	24	1	42	30	24	2	6	23	24	43
18	1	19	0	24	1	42	54	24	2	6	47	24	42
19	1	19	24	24	1	43	18	24	2	7	11	23	41
20	1	19	48	23	1	43	42	24	2	7	34	24	40
21	1	20	11	24	1	44	6	24	2	7	58	24	39
22	1	20	35	24	1	44	30	23	2	8	22	24	38
23	1	20	59	24	1	44	53	24	2	8	46	24	37
24	1	21	23	24	1	45	17	24	2	9	10	24	36
25	1	21	47	24	1	45	41	24	2	9	34	24	35
26	1	22	11	24	1	46	5	24	2	9	58	23	34
27	1	22	35	24	1	46	29	24	2	10	21	24	33
28	1	22	59	24	1	46	53	24	2	10	45	24	32
29	1	23	23	24	1	47	17	24	2	11	9	24	31
30	1	23	47	24	1	47	41	24	2	11	33	24	30
		26				25				24			

Virgo. Pisces.

	3			dif.	4			dif	5			dif	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	De.	Min.	Se.	Se	mi.
30	1	23	47	24	1	47	41	24	2	11	33	24	30
31	1	24	11	23	1	48	5	23	2	11	57	24	29
32	1	24	34	24	1	48	28	24	2	12	21	24	28
33	1	24	58	24	1	48	52	24	2	12	45	23	27
34	1	25	22	24	1	49	16	24	2	13	8	24	26
35	1	25	46	24	1	49	40	24	2	13	32	24	25
36	1	26	10	24	1	50	4	24	2	13	56	24	24
37	1	26	34	24	1	50	28	24	2	14	20	24	23
38	1	26	58	24	1	50	52	24	2	14	44	24	22
39	1	27	22	24	1	51	16	23	2	15	8	23	21
40	1	27	46	24	1	51	39	24	2	15	31	24	20
41	1	28	10	24	1	52	3	24	2	15	55	24	19
42	1	28	34	23	1	52	27	24	2	16	19	24	18
43	1	28	57	24	1	52	51	24	2	16	43	24	17
44	1	29	21	24	1	53	15	24	2	17	7	24	16
45	1	29	45	24	1	53	39	24	2	17	31	24	15
46	1	30	9	24	1	54	3	24	2	17	55	23	14
47	1	30	33	24	1	54	27	24	2	18	18	24	13
48	1	30	87	24	1	54	51	23	2	18	42	24	12
49	1	31	21	24	1	55	14	24	2	19	6	24	11
50	1	31	45	24	1	55	38	24	2	19	30	24	10
51	1	32	9	24	1	56	2	24	2	19	54	24	9
52	1	32	33	24	1	56	26	24	2	20	18	23	8
53	1	32	57	23	1	56	50	24	2	20	41	24	7
54	1	33	20	24	1	57	14	24	2	21	5	24	6
55	1	33	44	24	1	57	38	24	2	21	29	24	5
56	1	34	8	24	1	58	2	23	2	21	53	24	4
57	1	34	32	24	1	58	25	24	2	22	17	24	3
58	1	34	56	24	1	58	49	24	2	22	41	24	2
59	1	35	20	24	1	59	13	24	2	23	5	23	1
60	1	35	44	24	1	59	37	24	2	23	28	24	0
		26				25				24			

	6	dif.	7	dif.	8	dif.	
mi.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
0	2 23 28	24	2 47 18	23	3 11 4	24	60
1	2 23 52	24	2 47 41	24	3 11 28	24	59
2	2 24 16	24	2 48 5	24	3 11 52	23	58
3	2 24 40	24	2 48 29	24	3 12 15	24	57
4	2 25 4	24	2 48 53	24	3 12 39	24	56
5	2 25 28	23	2 49 17	23	3 13 3	24	55
6	2 25 51	24	2 49 40	24	3 13 27	23	54
7	2 26 15	24	2 50 4	24	3 13 50	24	53
8	2 26 39	24	2 50 28	24	3 14 14	24	52
9	2 27 3	24	2 50 52	23	3 14 38	24	51
10	2 27 27	24	2 51 15	24	3 15 2	23	50
11	2 27 51	23	2 51 39	24	3 15 25	24	49
12	2 28 14	24	2 52 3	24	3 15 49	24	48
13	2 28 38	24	2 52 27	24	3 16 13	24	47
14	2 29 2	24	2 52 51	23	3 16 37	23	46
15	2 29 26	24	2 53 14	24	3 17 0	24	45
16	2 29 50	24	2 53 38	24	3 17 24	24	44
17	9 30 14	23	2 54 2	24	3 17 48	24	43
18	2 30 37	24	2 54 26	24	3 18 12	23	42
19	2 31 1	24	2 54 50	23	3 18 35	24	41
20	2 31 25	24	2 55 13	24	3 18 59	24	40
21	2 31 49	24	2 55 37	24	3 19 23	23	39
22	2 32 13	23	2 56 1	24	3 19 46	24	38
23	2 32 36	24	2 56 25	23	3 20 10	24	37
24	2 33 0	24	2 56 48	24	3 20 34	24	36
25	2 33 24	24	2 57 12	24	3 20 58	23	35
26	2 33 48	24	2 57 36	24	3 21 21	24	34
27	2 34 12	24	2 58 0	24	3 21 45	24	33
28	2 34 36	23	2 58 24	23	3 22 9	24	32
29	2 34 59	24	2 58 47	24	3 22 33	23	31
30	2 35 23	24	2 59 11	24	3 22 56	24	30
	23		22		21		

mi.	6 Deg. Deg. Mi. Se	dif. Se.	7 Deg. Deg. Mi. Se.	dif. Se	8 Deg. De. Min. Se	dif. Se	mi.
30	2 35 23	24	2 59 11	24	3 22 56	24	30
31	2 35 47	24	2 59 35	24	3 23 20	24	29
32	2 36 11	24	2 59 59	23	3 23 44	23	28
33	2 36 35	24	3 0 22	24	3 24 7	24	27
34	2 36 59	23	3 0 46	24	3 24 31	24	26
35	2 37 22	24	3 1 10	24	3 24 55	24	25
36	2 37 46	24	3 1 34	24	3 25 19	23	24
37	2 38 10	24	3 1 58	23	3 25 42	24	23
38	2 38 34	24	3 2 21	24	3 26 6	24	22
39	2 38 58	23	3 2 45	24	3 26 30	24	21
40	2 39 21	24	3 3 9	24	3 26 54	23	20
41	2 39 45	24	3 3 33	23	3 27 17	24	19
42	2 40 9	24	3 3 56	24	3 27 41	24	18
43	2 40 33	24	2 4 20	24	3 28 5	23	17
44	2 40 57	23	3 4 44	24	3 28 28	24	16
45	2 41 20	24	3 5 8	23	3 28 52	24	15
46	2 41 44	24	3 5 31	24	3 29 16	24	14
47	2 42 8	24	3 5 55	24	3 29 40	23	13
48	2 42 32	24	3 6 19	24	3 30 3	24	12
49	2 42 56	24	3 6 43	24	3 30 27	24	11
50	2 43 20	23	3 7 7	23	3 30 51	23	10
51	2 43 43	24	3 7 30	24	3 31 14	24	9
52	2 44 7	24	3 7 54	24	3 31 38	24	8
53	2 44 31	24	3 8 18	24	3 32 2	23	7
54	2 44 55	24	3 8 42	23	3 32 25	24	6
55	2 45 19	23	3 9 5	24	3 32 49	24	5
56	2 45 42	24	3 9 29	24	3 33 13	24	4
57	2 46 6	24	3 9 53	24	3 33 37	23	3
58	2 46 30	24	3 10 17	23	3 34 0	24	2
59	2 46 54	24	3 10 40	24	3 34 24	24	1
60	2 47 18	23	3 11 4	24	3 34 48	23	0
	23 Deg.		22 Deg.		21 Deg.		

	9	dif	10	dif	11	dif	
mi.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
0	3 34 48	23	3 58 28	24	4 22 5	23	60
1	3 35 11	24	3 58 52	23	4 22 28	24	59
2	3 35 35	24	3 59 15	24	4 22 52	23	58
3	3 35 59	23	3 59 39	24	4 23 15	24	57
4	3 36 22	24	4 0 3	23	4 23 39	23	56
5	3 36 46	24	4 0 26	24	4 24 2	24	55
6	3 37 10	24	4 0 50	23	4 24 26	24	54
7	3 37 34	23	4 1 13	24	4 24 50	23	53
8	3 37 57	24	4 1 37	24	4 25 13	24	52
9	3 38 21	24	4 2 1	23	4 25 37	23	51
10	3 38 45	23	4 2 24	24	4 26 0	24	50
11	3 39 8	24	4 2 48	24	4 26 24	23	49
12	3 39 32	24	4 3 12	23	4 26 47	24	48
13	3 39 56	23	4 3 35	24	4 27 11	24	47
14	3 40 19	24	4 3 59	24	4 27 35	23	46
15	3 40 43	24	4 4 23	23	4 27 58	24	45
16	3 41 7	23	4 4 46	24	4 28 22	23	44
17	3 41 30	24	4 5 10	23	4 28 45	24	43
18	3 41 54	24	4 5 33	24	4 29 9	23	42
19	3 42 18	24	4 5 57	24	4 29 32	24	41
20	3 42 42	23	4 6 21	23	4 29 56	23	40
21	3 43 5	24	4 6 44	24	4 30 19	24	39
22	3 43 29	24	4 7 8	23	4 30 43	24	38
23	3 43 53	23	4 7 31	24	4 31 7	23	37
24	3 44 16	24	4 7 55	24	4 31 30	24	36
25	3 44 40	24	4 8 19	23	4 31 54	23	35
26	3 45 4	23	4 8 42	24	4 32 17	24	34
27	3 45 27	24	4 9 6	24	4 32 41	23	33
28	3 45 51	24	4 9 30	23	4 33 4	24	32
29	3 46 15	23	4 9 53	24	4 33 28	23	31
30	3 46 38	24	4 10 17	23	4 33 51	24	30
	20		19		18		

	9		dif.	10		dif.	11		dif.	
mi.	Deg.	Mi. Se.	Se.	Deg.	Mi. Se.	Se.	Deg.	Mi. Se.	Se.	mi.
30	3	46 38	24	4	10 17	23	4	33 51	24	30
31	3	47 2	24	4	10 40	24	4	34 15	24	29
32	3	47 26	23	4	11 4	24	4	34 39	23	28
33	3	47 49	24	4	11 28	23	4	35 2	24	27
34	3	48 13	24	4	11 51	24	4	35 26	23	26
35	3	48 37	23	4	12 15	23	4	35 49	24	25
36	3	49 0	24	4	12 38	24	4	36 13	23	24
37	3	49 24	24	4	13 2	24	4	36 36	24	23
38	3	49 48	23	4	13 26	23	4	37 0	23	22
39	3	50 11	24	4	13 49	24	4	37 23	24	21
40	3	50 35	24	4	14 13	23	4	37 47	23	20
41	3	50 59	23	4	14 36	24	4	38 10	24	19
42	3	51 22	24	4	15 0	24	4	38 34	23	18
43	3	51 46	24	4	15 24	23	4	38 57	24	17
44	3	52 10	23	4	16 47	24	4	39 21	23	16
45	3	52 33	24	4	16 11	23	4	39 44	24	15
46	3	52 57	24	4	16 34	24	4	40 8	23	14
47	3	53 21	23	4	16 58	24	4	40 31	24	13
48	3	53 44	24	4	17 22	23	4	40 55	24	12
49	3	54 8	24	4	17 45	24	4	41 19	23	11
50	3	54 32	23	4	18 9	23	4	41 42	24	10
51	3	54 55	24	4	18 32	24	4	42 6	23	9
52	3	55 19	23	4	18 56	24	4	42 29	24	8
53	3	55 42	24	4	19 20	23	4	42 53	23	7
54	3	56 6	24	4	19 43	24	4	43 16	24	6
55	3	56 30	23	4	20 7	23	4	43 40	23	5
56	3	56 53	24	4	20 30	24	4	44 3	24	4
57	3	57 17	24	4	20 54	23	4	44 27	23	3
58	3	57 41	23	4	21 17	24	4	44 50	24	2
59	3	58 4	24	4	21 41	24	4	45 14	23	1
60	3	58 28	24	4	22 5	23	4	45 37	23	0
		20			19			18		

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	4	45	37	23	5	9	5	24	5	32	29	23	60
1	4	46	0	24	5	9	29	23	5	32	52	23	59
2	4	46	24	24	5	9	52	24	5	33	15	24	58
3	4	46	48	23	5	10	16	23	5	33	39	23	57
4	4	47	11	24	5	10	39	23	5	34	2	23	56
5	4	47	35	23	5	11	2	24	5	34	25	24	55
6	4	47	58	24	5	11	26	23	5	34	49	23	54
7	4	48	22	23	5	11	49	24	5	35	12	23	53
8	4	48	45	24	5	12	13	23	5	35	35	24	52
9	4	49	9	23	5	12	36	24	5	35	59	23	51
10	4	49	32	24	5	13	0	23	5	36	22	23	50
11	4	49	56	23	5	13	23	23	5	36	45	24	49
12	4	50	19	24	5	13	46	24	5	37	9	23	48
13	4	50	43	23	5	14	10	23	5	37	32	23	47
14	4	51	6	24	5	14	33	23	5	37	55	24	46
15	4	51	30	23	5	14	56	24	5	38	19	23	45
16	4	51	53	24	5	15	20	23	5	38	42	23	44
17	4	52	17	23	5	15	43	24	5	39	5	24	43
18	4	52	40	24	5	16	7	23	5	39	29	23	42
19	4	53	4	23	5	16	30	23	5	39	52	23	41
20	4	53	27	24	5	16	53	24	5	40	15	24	40
21	4	53	51	23	5	17	17	23	5	40	39	23	39
22	4	54	14	24	5	17	40	24	5	41	2	23	38
23	4	54	38	23	5	18	4	23	5	41	25	24	37
24	4	55	1	23	5	18	27	23	5	41	49	23	36
25	4	55	24	24	5	18	50	24	5	42	12	23	35
26	4	55	48	23	5	19	14	23	5	42	35	23	34
27	4	56	11	24	5	19	37	24	5	42	58	24	33
28	4	56	35	23	5	20	1	23	5	43	22	23	32
29	4	56	58	24	5	20	24	24	5	43	45	23	31
30	4	57	22	23	5	20	48	23	5	44	8	24	30
		17				16				15			

Virgo Pisces

	12		dif.	13		dif.	14		dif.	
mi.	*Deg.*	*Mi. Se.*	*Se.*	*Deg.*	*Mi. Se.*	*Se.*	*Deg.*	*Mi. Se.*	*Se.*	*mi.*
30	4	57 22	23	5	20 48	23	5	44 8	24	30
31	4	57 45	24	5	21 11	23	5	44 32	23	29
32	4	58 9	23	5	21 34	24	5	44 55	23	28
33	4	58 32	24	5	21 58	23	5	45 18	24	27
34	4	58 56	23	5	22 21	24	5	45 42	23	26
35	4	59 19	24	5	22 45	23	5	46 5	23	25
36	4	59 43	23	5	23 8	23	5	46 28	23	24
37	5	0 6	24	5	23 31	24	5	46 51	24	23
38	5	0 30	23	5	23 55	23	5	47 15	23	22
39	5	0 53	23	5	24 18	23	5	47 38	23	21
40	5	1 16	24	5	24 41	24	5	48 1	24	20
41	5	1 40	23	5	25 5	23	5	48 25	23	19
42	5	2 3	24	5	25 28	23	5	48 48	23	18
43	5	2 27	23	5	25 51	24	5	49 11	23	17
44	5	2 50	24	5	26 15	23	5	49 34	24	16
45	5	3 14	23	5	26 38	24	5	49 58	23	15
46	5	3 37	24	5	27 2	23	5	50 21	23	14
47	5	4 1	23	5	27 25	23	5	50 44	24	13
48	5	4 24	23	5	27 48	24	5	51 8	23	12
49	5	4 47	24	5	28 12	23	5	51 31	23	11
50	5	5 11	23	5	28 35	23	5	51 54	23	10
51	5	5 34	24	5	28 58	24	5	52 17	24	9
52	5	5 58	23	5	29 22	23	5	52 41	23	8
53	5	6 21	24	5	29 45	24	5	53 4	23	7
54	5	6 45	23	5	30 9	23	5	53 27	23	6
55	5	7 8	24	5	30 32	23	5	53 50	24	5
56	5	7 32	23	5	30 55	24	5	54 14	23	4
57	5	7 55	23	5	31 19	23	5	54 37	23	3
58	5	8 18	24	5	31 42	23	5	55 0	24	2
59	5	8 42	23	5	32 5	24	5	55 24	23	1
60	5	9 5	24	5	32 29	23	5	55 47	23	0
		17			16			15		

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
0	5	55	47	23	6	18	59	24	6	42	6	23	60
1	5	56	10	23	6	19	23	23	6	42	29	23	59
2	5	56	33	23	6	19	46	23	6	42	52	23	58
3	5	56	56	24	6	20	9	23	6	43	15	23	57
4	5	57	20	23	6	20	32	23	6	43	38	23	56
5	5	57	43	23	6	20	55	23	6	44	1	23	55
6	5	58	6	24	6	21	18	23	6	44	24	23	54
7	5	58	30	23	6	21	41	24	6	44	47	23	53
8	5	58	53	23	6	22	5	23	6	45	10	24	52
9	5	59	16	23	6	22	28	23	6	45	34	23	51
10	5	59	39	24	6	22	51	23	6	45	57	23	50
11	6	0	3	23	6	23	14	23	6	46	20	23	49
12	6	0	26	23	6	23	37	23	6	46	43	23	48
13	6	0	49	23	6	24	0	23	6	47	6	23	47
14	6	1	12	23	6	24	23	24	6	47	29	23	46
15	6	1	35	24	6	24	47	23	6	47	52	23	45
16	6	1	59	23	6	25	10	23	6	48	15	23	44
17	6	2	22	23	6	25	33	23	6	48	38	23	43
18	6	2	45	23	6	25	56	23	6	49	1	23	42
19	6	3	8	24	6	26	19	23	6	49	24	23	41
20	6	3	32	23	6	26	42	23	6	49	47	23	40
21	6	3	55	23	6	27	5	24	6	50	10	23	39
22	6	4	18	23	6	27	29	23	6	50	33	23	38
23	6	4	41	23	6	27	52	23	6	50	56	23	37
24	6	5	5	23	6	28	15	23	6	51	19	23	36
25	6	5	28	23	6	28	38	23	6	51	42	23	35
26	6	5	51	23	6	29	1	23	6	52	5	23	34
27	6	6	14	23	6	29	24	23	6	52	28	23	33
28	6	6	37	24	6	29	47	23	6	52	51	23	32
29	6	7	1	23	6	30	10	23	6	53	14	23	31
30	6	7	24	23	6	30	33	24	6	53	37	23	30
		14				13				12			

	15			dif.	16			dif.	17			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*mi.*
30	6	7	24	23	6	30	33	24	6	53	37	23	30
31	6	7	47	23	6	30	57	23	6	54	0	23	29
32	6	8	10	23	6	31	20	23	6	54	23	23	28
33	6	8	33	24	6	31	43	23	6	54	46	23	27
34	6	8	57	23	6	32	6	23	6	55	9	23	26
35	6	9	20	23	6	32	29	23	6	55	32	23	25
36	6	9	43	23	6	32	52	23	6	55	55	23	24
37	6	10	6	23	6	33	15	23	6	56	18	23	23
38	6	10	29	24	6	33	38	23	6	56	41	23	22
39	6	10	53	23	6	34	1	24	6	57	4	23	21
40	6	11	16	23	6	34	25	23	6	57	27	23	20
41	6	11	39	23	6	34	48	23	6	57	50	23	19
42	6	12	2	23	6	35	11	23	6	58	13	23	18
43	6	12	25	24	6	35	34	23	6	58	36	23	17
44	6	12	49	23	6	35	57	23	6	58	59	23	16
45	6	13	12	23	6	36	20	23	6	59	22	23	15
46	6	13	35	23	6	36	43	23	6	59	45	23	14
47	6	13	58	23	6	37	6	23	7	0	8	23	13
48	6	14	21	24	6	37	29	23	7	0	31	23	12
49	6	14	45	23	6	37	52	23	7	0	54	23	11
50	6	15	8	23	6	38	15	23	7	1	17	23	10
51	6	15	31	23	6	38	38	24	7	1	40	23	9
52	6	15	54	23	6	39	2	23	7	2	3	23	8
53	6	16	17	23	6	39	25	23	7	2	26	23	7
54	6	16	40	24	6	39	48	23	7	2	49	23	6
55	6	17	4	23	6	40	11	23	7	3	12	23	5
56	6	17	27	23	6	40	34	23	7	3	35	23	4
57	6	17	50	23	6	40	57	23	7	3	58	23	3
58	6	18	13	23	6	41	20	23	7	4	21	23	2
59	6	18	36	23	6	41	43	23	7	4	44	22	1
60	6	18	59	24	6	42	6	23	7	5	6	23	0
		14				13				12			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	7	5	6	23	7	28	0	23	7	50	47	23	60
1	7	5	29	23	7	28	23	23	7	51	10	22	59
2	7	5	52	23	7	28	46	23	7	51	32	23	58
3	7	6	15	23	7	29	9	23	7	51	55	23	57
4	7	6	38	23	7	29	32	22	7	52	18	22	56
5	7	7	1	23	7	29	54	23	7	52	40	23	55
6	7	7	24	22	7	30	17	23	7	53	3	23	54
7	7	8	47	23	7	30	40	23	7	53	26	23	53
8	7	8	10	23	7	31	3	23	7	53	49	22	52
9	7	8	33	23	7	31	26	22	7	54	11	23	51
10	7	8	56	23	7	31	48	23	7	54	34	23	50
11	7	9	19	23	7	32	11	23	7	54	57	22	49
12	7	9	42	23	7	32	34	23	7	55	19	23	48
13	7	10	5	23	7	32	57	23	7	55	42	23	47
14	7	10	28	23	7	33	20	23	7	56	5	22	46
15	7	10	51	22	7	33	43	22	7	56	27	23	45
16	7	11	13	23	7	34	5	23	7	56	50	23	44
17	7	11	36	23	7	34	28	23	7	57	13	22	43
18	7	11	59	23	7	34	51	23	7	57	35	23	42
19	7	12	22	23	7	35	14	23	7	57	58	23	41
20	7	12	45	23	7	35	37	22	7	58	21	22	40
21	7	13	8	23	7	35	59	23	7	58	43	23	39
22	7	13	31	23	7	36	22	23	7	59	6	23	38
23	7	13	54	23	7	36	45	23	7	59	29	22	37
24	7	14	17	23	7	37	8	23	7	59	51	23	36
25	7	14	40	23	7	37	31	22	8	0	14	23	35
26	7	15	3	22	7	37	53	23	8	0	37	22	34
27	7	15	25	23	7	38	16	23	8	0	59	23	33
28	7	15	48	23	7	38	39	23	8	1	22	23	32
29	7	16	11	23	7	39	2	22	8	2	45	23	31
30	7	16	34	23	7	39	24	23	8	2	8		30
		11				10				9			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	7	16	34	23	7	39	24	23	8	2	8	23	30
31	7	16	57	23	7	39	47	23	8	2	31	23	29
32	7	17	20	23	7	40	10	23	8	2	54	22	28
33	7	17	43	23	7	40	33	23	8	3	16	23	27
34	7	18	6	23	7	40	56	22	8	3	39	23	26
35	7	18	29	23	7	41	18	23	8	4	2	22	25
36	7	18	52	22	7	41	41	23	8	4	24	23	24
37	7	19	14	23	7	42	4	23	8	4	47	22	23
38	7	19	37	23	7	42	27	22	8	5	9	22	22
39	7	20	0	23	7	42	49	23	8	5	31	23	21
40	7	20	23	23	7	43	12	23	8	5	54	23	20
41	7	20	46	23	7	43	35	23	8	6	17	22	19
42	7	21	9	23	7	43	58	22	8	6	39	23	18
43	7	21	32	23	7	44	20	23	8	7	2	22	17
44	7	21	55	22	7	44	43	23	8	7	24	23	16
45	7	22	17	23	7	45	6	23	8	7	47	23	15
46	7	22	40	23	7	45	29	22	8	8	10	22	14
47	7	23	3	23	7	45	51	23	8	8	32	23	13
48	7	23	26	23	7	46	14	23	8	8	55	23	12
49	7	23	49	23	7	46	37	23	8	9	18	22	11
50	7	24	12	23	7	47	0	22	8	9	40	23	10
51	7	24	35	22	7	47	22	23	8	10	3	22	9
52	7	24	57	23	7	47	45	23	8	10	25	23	8
53	7	25	20	23	7	48	8	23	8	10	48	23	7
54	7	25	43	24	7	48	31	22	8	11	11	22	6
55	7	26	6	23	7	48	53	23	8	11	33	23	5
56	7	26	29	23	7	49	16	23	8	11	56	22	4
57	7	26	52	23	7	49	39	22	8	12	18	23	3
58	7	27	15	22	7	50	1	23	8	12	41	23	2
59	7	27	37	23	7	50	24	23	8	13	4	22	1
60	7	28	0	23	7	50	47	23	8	13	36	23	0
		11				10				9			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	8	13	26	23	8	35	58	22	8	58	21	22	60
1	8	13	49	22	8	36	20	23	8	58	43	23	59
2	8	14	11	23	8	36	43	22	8	59	6	22	58
3	8	14	34	22	8	37	5	22	8	59	28	22	57
4	8	14	56	23	8	37	27	23	8	59	50	22	56
5	8	15	19	23	8	37	50	22	9	0	12	23	55
6	8	15	42	22	8	38	12	23	9	0	35	22	54
7	8	16	4	23	8	38	35	22	9	0	57	22	53
8	8	16	27	22	8	38	57	23	9	1	19	23	52
9	8	16	49	23	8	39	20	22	9	1	42	22	51
10	8	17	12	23	8	39	42	23	9	2	4	22	50
11	8	77	35	22	8	40	5	22	9	2	26	23	49
12	8	17	57	23	8	40	27	22	9	2	49	22	48
13	8	18	20	22	8	40	49	23	9	3	11	22	47
14	8	18	42	23	8	41	12	22	9	3	33	22	46
15	8	19	5	22	8	41	34	23	9	3	55	23	45
16	8	19	27	23	8	41	57	22	9	4	18	22	44
17	8	19	50	22	8	42	19	22	9	4	40	22	43
18	8	20	12	23	8	42	41	23	9	5	2	23	42
19	8	20	35	23	8	43	4	22	9	5	25	22	41
20	8	20	58	22	8	43	26	23	9	5	47	22	40
21	8	21	20	23	8	43	49	22	9	6	9	22	39
22	8	21	43	22	8	44	11	23	9	6	31	23	38
23	8	22	5	23	8	44	34	22	9	6	54	22	37
24	8	22	28	22	8	44	56	22	9	7	16	22	36
25	8	22	50	23	8	45	18	23	9	7	38	22	35
26	8	23	13	22	8	45	41	22	9	8	0	23	34
27	8	23	35	23	8	46	3	23	9	8	23	22	33
28	8	23	58	22	8	46	26	22	9	8	45	22	32
29	8	24	20	23	8	46	48	22	9	9	7	22	31
30	8	24	43	22	8	47	10	23	9	9	29	23	30
		8				7				6			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	8	24	43	22	8	47	10	23	9	9	29	23	30
31	8	25	5	23	8	47	33	22	9	9	52	22	29
32	8	25	28	22	8	47	55	22	9	10	14	22	28
33	8	25	50	23	8	48	17	23	9	10	36	22	27
34	8	26	13	22	8	48	40	22	9	10	58	23	26
35	8	26	35	23	8	49	2	23	9	11	21	22	25
36	8	26	58	23	8	49	25	22	9	11	43	22	24
37	8	27	21	22	8	49	47	22	9	12	5	22	23
38	8	27	43	23	8	50	9	23	9	12	27	23	22
39	8	28	6	22	8	50	32	22	9	12	50	22	21
40	8	28	28	23	8	50	54	22	9	13	12	22	20
41	8	28	51	22	8	51	16	23	9	13	34	22	19
42	8	29	13	23	8	51	39	22	9	13	56	22	18
43	8	29	36	22	8	52	1	23	9	14	18	23	17
44	8	29	58	23	8	52	24	22	9	14	41	22	16
45	8	30	21	22	8	52	46	22	9	15	3	22	15
46	8	30	43	22	8	53	8	23	9	15	25	22	14
47	8	31	5	23	8	53	31	22	9	15	47	22	13
48	8	31	28	22	8	53	53	22	9	16	9	23	12
49	8	31	50	23	8	54	15	23	9	16	32	22	11
50	8	32	13	22	8	54	38	22	9	16	54	22	10
51	8	32	35	23	8	55	0	22	9	17	16	22	9
52	8	32	58	22	8	55	22	23	9	17	38	22	8
53	8	33	20	23	8	55	45	22	9	18	0	23	7
54	8	33	43	22	8	56	7	22	9	18	23	22	6
55	8	34	5	23	8	56	29	22	9	18	45	22	5
56	8	34	28	22	8	56	51	23	9	19	7	22	4
57	8	34	50	23	8	57	14	22	9	19	29	22	3
58	8	35	13	22	8	57	36	23	9	19	51	23	2
59	8	35	35	23	8	57	59	22	9	20	14	22	1
60	8	35	58	22	8	58	21	22	9	20	36	22	0
		8				7				6			

	24			dif.	25			dif.	26			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se*	*mi.*
0	9	20	36	22	9	42	42	22	10	4	38	22	60
1	9	20	58	22	9	43	4	22	10	5	0	22	59
2	9	21	20	22	9	43	26	22	10	5	22	22	58
3	9	21	42	22	9	43	48	22	10	5	44	21	57
4	9	22	4	23	9	44	10	22	10	6	5	22	56
5	9	22	27	22	9	44	32	22	10	6	27	22	55
6	9	22	49	22	9	44	54	22	10	6	49	22	54
7	9	23	11	22	9	45	16	22	10	7	11	22	53
8	9	23	33	22	9	45	38	22	10	7	33	22	52
9	9	23	55	22	9	46	0	22	10	7	55	22	51
10	9	24	17	22	9	46	22	22	10	8	17	21	50
11	9	24	39	23	9	46	44	22	10	8	38	22	49
12	9	25	2	22	9	47	6	22	10	9	0	22	48
13	9	25	24	22	9	47	28	22	10	9	22	22	47
14	9	25	46	22	9	47	50	22	10	9	44	22	46
15	9	26	8	22	9	48	12	22	10	10	6	21	45
16	9	26	30	22	9	48	34	22	10	10	27	22	44
17	9	26	52	22	9	48	56	21	10	10	49	22	43
18	9	27	14	23	9	49	17	22	10	11	11	22	42
19	9	27	37	22	9	49	39	22	10	11	33	22	41
20	9	27	59	22	9	50	1	22	10	11	55	22	40
21	9	28	21	22	9	50	23	22	10	12	17	21	39
22	9	28	43	22	9	50	45	22	10	12	38	22	38
23	9	29	5	23	9	51	7	22	10	13	0	22	37
24	9	29	27	22	9	51	29	22	10	13	22	22	36
25	9	29	49	22	9	51	51	22	10	13	44	22	35
26	9	30	11	22	9	52	13	22	10	14	6	21	34
27	9	30	33	23	9	52	35	22	10	14	27	22	33
28	9	30	56	22	9	52	57	22	10	14	49	22	32
29	9	31	18	22	9	53	19	22	10	15	11	22	31
30	9	31	40	22	9	53	41	22	10	15	33	21	30
		5				4				3			

	24			dif.	25			dif.	26			dif	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*mi.*
30	9	31	40	22	9	53	41	22	10	15	33	21	30
31	9	32	2	22	9	54	3	22	10	15	54	22	29
32	9	32	24	22	9	54	25	22	10	16	16	22	28
33	9	32	46	22	9	54	47	22	10	16	38	22	27
34	9	33	8	22	9	55	9	22	10	17	0	22	26
35	9	33	30	22	9	55	31	22	10	17	22	21	25
36	9	33	52	22	9	55	53	22	10	17	43	22	24
37	9	34	14	22	9	56	15	21	10	18	5	22	23
38	9	34	36	23	9	56	36	22	10	18	27	22	22
39	9	34	59	22	9	56	58	22	10	18	49	21	21
40	9	35	21	22	9	57	20	22	10	19	10	22	20
41	9	35	43	22	9	57	42	22	10	19	32	22	19
42	9	36	5	22	9	58	4	22	10	19	54	22	18
43	9	36	27	22	9	58	26	22	10	20	16	21	17
44	9	36	49	22	9	58	48	22	10	20	37	22	16
45	9	37	11	22	9	59	10	22	10	20	59	22	15
46	9	37	33	22	9	59	32	22	10	21	21	22	14
47	9	37	55	22	9	50	54	22	10	21	43	21	13
48	9	38	17	22	10	0	16	21	10	22	4	22	12
49	9	38	39	22	10	0	37	22	10	22	26	22	11
50	9	39	1	22	10	0	59	22	10	22	48	21	10
51	9	39	23	22	10	1	21	22	10	23	9	22	9
52	9	39	45	22	10	1	43	22	10	23	31	22	8
53	9	40	7	22	10	2	5	22	10	23	53	22	7
54	9	40	29	22	10	2	27	22	10	24	15	21	6
55	9	40	41	22	10	2	49	22	10	24	36	22	5
56	9	41	13	22	10	3	11	21	10	24	58	22	4
57	9	41	35	22	10	3	32	22	10	25	20	21	3
58	9	31	57	22	10	3	54	22	10	25	41	22	2
59	9	42	19	23	10	4	16	22	10	26	3	22	1
60	9	42	42	22	10	4	38	22	10	26	25	22	0
		5				4				3			

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	10	26	25	22	10	48	2	21	11	9	28	21	60
1	10	26	47	21	10	48	23	22	11	9	49	22	59
2	10	27	8	22	10	48	45	21	11	10	11	21	58
3	10	27	30	22	10	49	6	22	11	10	32	21	57
4	10	27	52	21	10	49	28	21	11	10	53	22	56
5	10	28	13	22	10	49	49	22	11	11	15	21	55
6	10	28	35	22	10	50	11	21	11	11	36	21	54
7	10	28	57	21	10	50	32	22	11	11	57	22	53
8	10	29	18	22	10	50	54	21	11	12	19	21	52
9	10	29	40	22	10	51	15	22	11	12	40	21	51
10	10	30	2	21	10	51	37	21	11	13	1	22	50
11	10	30	23	22	10	51	58	22	11	13	23	21	49
12	10	30	45	22	10	52	20	21	11	13	44	21	48
13	10	31	7	21	10	52	41	22	11	14	5	22	47
14	10	31	28	22	10	53	3	21	11	14	27	21	46
15	10	31	50	22	10	53	24	22	11	14	48	21	45
16	10	32	12	21	10	53	46	21	11	15	9	22	44
17	10	32	33	22	10	54	7	22	11	15	31	21	43
18	10	32	55	22	10	54	29	21	11	15	52	21	42
19	10	33	17	21	10	54	50	22	11	16	13	21	41
20	10	33	38	22	10	55	12	21	11	16	34	22	40
21	10	34	0	22	10	55	33	22	11	16	56	21	39
22	10	34	22	21	10	55	55	21	11	17	17	21	38
23	10	34	43	22	10	56	16	21	11	17	38	22	37
24	10	35	5	21	10	56	37	22	11	18	0	21	36
25	10	35	26	22	10	56	59	21	11	18	21	21	35
26	10	35	48	22	10	57	20	22	11	18	42	21	34
27	10	36	10	21	10	57	42	21	11	19	3	22	33
28	10	36	31	22	10	58	3	22	11	19	25	21	32
29	10	36	53	22	10	58	25	21	11	19	46	21	31
30	10	37	15	21	10	58	46	22	11	20	7	21	30
		2				1				0			

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	10	27	15	21	10	58	46	22	11	20	7	21	30
31	10	37	36	22	10	59	8	21	11	20	28	22	29
32	10	37	58	21	10	59	29	21	11	20	50	21	28
33	10	38	19	22	10	59	50	22	11	21	11	21	27
34	10	38	41	22	11	0	12	21	11	21	32	21	26
35	10	39	3	21	11	0	33	22	11	21	53	22	25
36	10	39	24	22	11	0	55	21	11	22	15	21	24
37	10	39	46	21	11	1	16	22	11	22	36	21	23
38	10	40	7	22	11	1	38	21	11	22	57	21	22
39	10	40	39	22	11	1	59	21	11	23	18	22	21
40	10	40	51	21	11	2	20	22	11	23	40	21	20
41	10	41	12	22	11	2	42	21	11	24	1	21	19
42	10	41	34	21	11	3	3	22	11	24	22	21	18
43	10	41	55	22	11	3	25	21	11	24	43	21	17
44	10	42	17	21	11	3	46	21	11	25	4	22	16
45	10	42	38	22	11	4	7	22	11	25	26	21	15
46	10	43	0	22	11	4	29	21	11	25	47	21	14
47	10	43	22	21	11	4	50	21	11	26	8	21	13
48	10	43	43	22	11	5	11	22	11	26	29	21	12
49	10	44	5	21	11	5	33	21	11	26	50	22	11
50	10	44	26	22	11	5	54	22	11	27	12	21	10
51	10	44	48	21	11	6	16	21	11	27	33	21	9
52	10	45	9	22	11	6	37	21	11	27	54	21	8
53	10	45	31	21	11	6	58	22	11	28	15	21	7
54	10	45	52	22	11	7	20	21	11	28	36	22	6
55	10	46	14	22	11	7	41	22	11	28	58	21	5
56	10	46	36	21	11	8	3	21	11	29	19	21	4
57	10	46	57	22	11	8	24	21	11	29	40	21	3
58	10	47	19	21	11	8	45	22	11	30	1	21	2
59	10	47	40	22	11	9	7	21	11	30	22	22	1
60	10	48	2	21	11	9	28	21	11	30	44	21	0
		2				1				0			

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	11	30	44	21	11	51	48	21	12	12	41	20	60
1	11	31	5	21	11	52	9	21	12	13	1	21	59
2	11	31	26	21	11	52	30	21	12	13	22	21	58
3	11	31	47	21	11	52	51	21	12	13	43	21	57
4	11	32	8	21	11	53	12	21	12	14	4	20	56
5	11	32	29	21	11	53	33	21	12	14	24	21	55
6	11	32	50	22	11	53	54	21	12	14	45	21	54
7	11	33	12	21	11	54	15	21	12	15	6	21	53
8	11	33	33	21	11	54	36	20	12	15	27	20	52
9	11	33	54	21	11	54	56	21	12	15	47	21	51
10	11	34	15	21	11	55	17	21	12	16	8	21	50
11	11	34	36	21	11	55	38	21	12	16	29	21	49
12	11	34	57	21	11	55	59	21	12	16	50	20	48
13	11	35	18	22	11	56	20	21	12	17	10	21	47
14	11	35	40	21	11	56	41	21	12	17	31	21	46
15	11	36	1	21	11	57	2	21	12	17	52	21	45
16	11	36	22	21	11	57	23	21	12	18	13	20	44
17	11	36	43	21	11	57	44	21	12	18	33	21	43
18	11	37	4	21	11	58	5	21	12	18	54	21	42
19	11	37	25	21	11	58	26	21	12	19	15	20	41
20	11	37	46	21	11	58	47	21	12	19	35	21	40
21	11	38	7	21	11	59	8	21	12	19	56	21	39
22	11	38	28	21	11	59	29	20	12	20	17	21	38
23	11	38	49	22	11	59	49	21	12	20	38	20	37
24	11	39	11	21	12	0	10	21	12	20	58	21	36
25	11	39	32	21	12	0	31	21	12	21	19	21	35
26	11	39	53	21	12	0	52	21	12	21	40	20	34
27	11	40	14	21	12	1	13	21	12	22	0	21	33
28	11	40	35	21	12	1	34	21	12	22	21	21	32
29	11	40	56	21	12	1	55	21	12	22	42	20	31
30	11	41	17	21	12	2	16	21	12	23	2	21	30
		29				28				27			

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	11	41	17	21	12	2	16	21	12	23	2	21	30
31	11	41	38	21	12	2	37	20	12	23	23	21	29
32	11	41	59	21	12	2	57	21	12	23	44	20	28
33	11	42	20	21	12	3	18	21	12	24	4	21	27
34	11	42	41	21	12	3	39	21	12	24	25	21	26
35	11	43	2	21	12	4	0	21	12	24	46	20	25
36	11	43	23	22	12	4	21	21	12	25	6	21	24
37	11	43	45	21	12	4	42	21	12	25	27	21	23
38	11	44	6	21	12	5	3	20	12	25	48	20	22
39	11	44	27	21	12	5	23	21	12	26	8	21	21
40	11	44	48	21	12	5	44	21	12	26	29	21	20
41	11	45	9	21	12	6	5	21	12	26	50	20	19
42	11	45	30	21	12	6	26	21	12	27	10	21	18
43	11	45	51	21	12	6	47	21	12	27	31	21	17
44	11	46	12	21	12	7	8	20	12	27	52	20	16
45	11	46	33	21	12	7	28	21	12	28	12	21	15
46	11	46	54	21	12	7	49	21	12	28	33	20	14
47	11	47	15	21	12	8	10	21	12	28	53	21	13
48	11	47	36	21	12	8	31	21	12	29	14	21	12
49	11	47	57	21	12	8	52	21	12	29	35	20	11
50	11	48	18	21	12	9	13	20	12	29	55	21	10
51	11	48	39	21	12	9	33	21	12	30	16	21	9
52	11	49	0	21	12	9	54	21	12	30	37	20	8
53	11	49	21	21	12	10	15	21	12	30	57	21	7
54	11	49	42	21	12	10	36	21	12	31	18	20	6
55	11	50	3	21	12	10	57	20	12	31	38	21	5
56	11	50	24	21	12	11	17	21	12	31	59	21	4
57	11	50	45	21	12	11	38	21	12	32	20	20	3
58	11	51	6	21	12	11	59	21	12	32	40	21	2
59	11	51	27	21	12	12	20	21	12	33	1	20	1
60	11	51	48	21	12	12	41	20	12	33	21	21	0
		29				28				27			

	3			dif.	4			dif.	5			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se	Sec.	mi.
0	12	33	21	21	12	53	50	20	13	14	5	21	60
1	12	33	42	20	12	54	10	20	13	14	26	20	59
2	12	34	2	21	12	54	30	21	13	14	46	20	58
3	12	34	23	21	12	54	51	20	13	15	6	20	57
4	12	34	44	20	12	55	11	20	13	15	26	20	56
5	12	35	4	21	12	55	31	21	13	15	46	20	55
6	12	35	25	20	12	55	52	20	13	16	6	20	54
7	12	35	45	21	12	56	12	21	13	16	26	20	53
8	12	36	6	20	12	56	33	20	13	16	46	21	52
9	12	36	26	21	12	56	53	20	13	17	7	20	51
10	12	36	47	20	12	57	13	21	13	17	27	20	50
11	12	37	7	21	12	57	34	20	13	17	47	20	49
12	12	37	28	20	12	57	54	20	13	18	7	20	48
13	12	37	48	21	12	58	14	20	13	18	27	20	47
14	12	38	9	21	12	58	34	21	13	18	47	20	46
15	12	38	30	20	12	58	55	20	13	19	7	20	45
16	12	38	50	21	12	59	15	20	13	19	27	20	44
17	12	39	11	20	12	59	35	21	13	19	47	21	43
18	12	39	31	21	12	59	56	20	13	20	8	20	42
19	12	39	52	20	13	0	16	20	13	20	28	20	41
20	12	40	12	21	13	0	36	21	13	20	48	20	40
21	12	40	33	20	13	0	57	20	13	21	8	20	39
22	12	40	53	21	13	1	17	20	13	21	28	20	38
23	12	41	14	20	13	1	37	21	13	21	48	20	37
24	12	41	34	21	13	1	58	20	13	22	8	20	36
25	12	41	55	20	13	2	18	20	13	22	28	20	35
26	12	42	15	21	13	2	38	20	13	22	48	20	34
27	12	42	36	20	13	2	58	21	13	23	8	20	33
28	12	42	56	21	13	3	19	20	13	23	28	20	32
29	12	43	17	20	13	3	39	20	13	23	48	20	31
30	12	43	37	21	13	3	59	20	13	24	8	20	30
		26				25				24			

	3 ♉			dif.	4 ♉			dif.	5 ♉			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*S.*	*mi.*
30	12	43	37	21	13	3	59	20	13	24	8	20	30
31	12	43	58	20	13	4	19	21	13	24	28	20	29
32	12	44	18	20	13	3	40	20	13	44	48	20	28
33	12	44	38	21	13	4	0	20	13	25	8	20	27
34	12	44	59	20	13	4	20	20	13	25	28	20	26
35	12	45	19	21	13	4	40	21	13	25	48	21	25
36	12	45	40	20	13	5	1	20	13	26	9	20	24
37	12	46	0	21	13	5	21	20	13	26	29	20	23
38	12	46	21	20	13	5	41	20	13	26	49	20	22
39	12	46	41	21	13	6	1	21	13	27	9	20	21
40	12	47	2	20	13	6	22	20	13	27	29	20	20
41	12	47	22	20	13	6	42	20	13	27	49	20	19
42	12	47	42	21	13	7	2	20	13	28	9	20	18
43	12	48	3	20	13	7	22	20	13	28	29	20	17
44	12	48	23	21	13	7	42	21	13	28	49	20	16
45	12	48	44	20	13	8	3	20	13	29	9	20	15
46	12	49	4	21	13	8	23	20	13	29	29	20	14
47	12	49	25	20	13	8	43	20	13	29	49	19	13
48	12	49	45	20	13	9	3	20	13	30	8	20	12
49	12	50	5	21	13	9	23	21	13	30	28	22	11
50	12	50	26	20	13	9	44	20	13	30	48	20	10
51	12	50	46	21	13	10	4	20	13	31	8	20	9
52	12	51	7	20	13	10	24	20	13	31	28	20	8
53	12	51	27	20	13	10	44	20	13	31	48	20	7
54	12	51	47	21	13	11	4	21	13	32	8	20	6
55	12	52	8	20	13	11	25	20	13	32	28	20	5
56	12	52	28	21	13	11	45	20	13	32	48	20	4
57	12	52	49	20	13	12	5	20	13	33	8	20	3
58	12	53	9	20	13	12	25	20	13	33	28	20	2
59	12	53	29	21	13	12	45	20	13	33	48	20	1
60	12	53	50	20	13	13	5	21	13	34	8	20	0
		26				25				24			

	6			dif.	7			dif.	8			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	13	34	8	20	13	53	57	20	14	13	32	20	60
1	13	34	28	20	13	54	17	19	14	13	52	19	59
2	13	24	48	20	13	54	36	20	14	14	11	20	58
3	13	35	8	20	13	54	56	20	14	14	31	19	57
4	13	35	28	20	13	55	16	19	14	14	50	20	56
5	13	35	48	19	13	55	35	20	14	15	10	19	55
6	13	36	7	20	13	55	55	20	14	55	29	19	54
7	13	36	27	20	13	56	15	20	14	15	48	20	53
8	13	36	47	20	13	56	35	19	14	16	8	19	52
9	13	37	7	20	13	56	54	20	14	16	27	20	51
10	13	37	27	20	13	57	14	20	14	16	47	19	50
11	13	37	47	20	13	57	34	19	14	17	6	20	49
12	13	38	7	20	13	57	53	20	14	17	26	19	48
13	13	38	27	20	13	58	13	19	14	17	45	19	47
14	13	38	47	19	13	58	32	20	14	18	4	20	46
15	13	39	6	20	13	58	52	20	14	18	24	19	45
16	13	39	26	20	13	59	12	19	14	18	43	20	44
17	13	39	46	20	13	59	31	20	14	19	3	19	43
18	13	40	6	20	13	59	51	20	14	19	22	19	42
19	13	40	26	20	14	0	11	19	14	19	41	20	41
20	13	40	46	20	14	0	30	20	14	20	1	19	40
21	13	41	6	20	14	0	50	20	14	20	20	20	39
22	13	41	26	20	14	1	10	19	14	20	40	19	38
23	13	41	46	19	14	1	29	20	14	20	59	19	37
24	13	42	5	20	14	1	49	19	14	21	18	20	36
25	13	42	25	20	14	2	8	20	14	21	38	19	35
26	13	42	45	20	14	2	28	20	14	21	57	19	34
27	13	43	5	20	14	2	48	19	14	22	16	20	33
28	13	43	25	19	14	3	7	20	14	22	36	19	32
29	13	43	44	20	14	3	27	19	14	22	55	20	31
30	13	44	4	20	14	3	46	20	14	23	15	19	30
		23				22				21			

	6			dif.	7			dif.	8			dif	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
30	13	44	4	20	14	3	46	20	14	23	15	19	30
31	13	44	24	20	14	4	6	20	14	23	34	19	29
32	13	44	44	20	14	4	26	19	14	23	53	20	28
33	13	45	4	19	14	4	45	20	14	24	13	19	27
34	13	45	23	20	14	5	5	19	14	24	32	19	26
35	13	45	43	20	14	5	24	20	14	24	51	20	25
36	13	46	3	20	14	5	44	19	14	25	11	19	24
37	13	46	23	20	14	6	3	20	14	25	30	19	23
38	13	46	43	19	14	6	23	20	14	25	49	19	22
39	13	47	2	20	14	6	43	19	14	26	8	20	21
40	13	47	22	20	14	7	2	20	14	26	28	19	20
41	13	47	42	20	14	7	22	19	14	26	47	19	19
42	13	48	2	19	14	7	41	20	14	27	6	20	18
43	13	48	21	20	14	8	1	19	14	27	26	19	17
44	13	48	41	20	14	8	20	20	14	27	45	19	16
45	13	49	1	20	14	8	40	19	14	28	4	20	15
46	13	49	21	20	14	8	59	20	14	28	24	19	14
47	13	49	41	19	14	9	19	19	14	28	43	19	13
48	13	50	0	20	14	9	38	20	14	29	2	19	12
49	13	50	20	20	14	9	58	19	14	29	21	20	11
50	13	50	40	20	14	10	17	20	14	29	41	19	10
51	13	51	0	19	14	10	37	19	14	30	0	19	9
52	13	51	19	20	14	10	56	20	14	30	19	19	8
53	13	51	39	20	14	11	16	19	14	30	38	20	7
54	13	51	59	19	14	11	35	20	14	30	58	19	6
55	13	52	18	20	14	11	55	19	14	31	17	19	5
56	13	52	38	20	14	12	14	20	14	31	36	19	4
57	13	52	58	20	14	12	34	19	14	31	55	20	3
58	13	53	18	19	14	12	53	20	14	32	15	19	2
59	13	53	37	20	14	13	13	19	14	32	34	19	1
60	13	53	57	20	14	13	32	20	14	32	53	19	0
		22				22				21			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	14	32	53	19	14	51	59	19	15	10	51	19	60
1	14	33	12	20	14	52	18	19	15	11	10	18	59
2	14	33	32	19	14	52	37	19	15	11	28	19	58
3	14	33	51	19	14	52	56	19	15	11	47	19	57
4	14	34	10	19	14	53	15	19	15	12	6	18	56
5	14	34	29	19	14	53	34	19	15	12	24	19	55
6	14	34	48	20	14	53	53	19	15	12	43	19	54
7	14	35	8	19	14	54	12	19	15	13	2	19	53
8	14	35	27	19	14	54	31	19	15	13	21	18	52
9	14	35	46	19	14	54	50	19	15	13	39	19	51
10	14	36	5	19	14	55	9	19	15	13	58	19	50
11	14	36	24	20	14	55	28	19	15	14	17	18	49
12	14	36	44	19	14	55	47	19	15	14	35	19	48
13	14	37	3	19	14	56	6	19	15	14	54	19	47
14	14	37	22	19	14	56	25	19	15	15	13	19	46
15	14	37	41	19	14	56	44	19	15	15	31	19	45
16	14	38	0	19	14	57	3	19	15	15	50	19	44
17	14	38	19	20	14	57	22	18	15	16	9	18	43
18	14	38	39	19	14	57	40	19	15	16	27	19	42
19	14	38	58	19	14	57	59	19	15	16	46	19	41
20	14	39	17	19	14	58	18	19	15	17	5	18	40
21	14	39	36	19	14	58	37	19	15	17	23	19	39
22	14	39	55	19	14	58	56	19	15	17	42	18	38
23	14	40	14	19	14	59	15	19	15	18	0	99	37
24	14	40	33	20	14	59	34	19	15	18	19	19	36
25	14	40	53	19	14	59	53	19	15	18	38	18	35
26	14	41	12	19	15	0	12	18	15	18	56	19	34
27	14	41	31	19	15	0	30	19	15	19	15	19	33
28	14	41	50	19	15	0	49	19	15	19	34	18	32
29	14	42	9	19	15	1	8	19	15	19	52	19	31
30	14	42	28	19	15	1	27	19	15	20	11	18	30
		20				19				18			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	14	42	28	19	15	1	27	19	15	20	11	18	30
31	14	42	47	19	15	1	46	19	15	20	29	19	29
32	14	43	6	19	15	2	5	19	15	20	48	19	28
33	14	43	25	20	15	2	24	18	15	21	7	18	27
34	14	43	45	19	15	2	44	19	15	21	25	19	26
35	14	44	4	19	15	3	1	19	15	21	44	18	25
36	14	44	23	19	15	3	20	19	15	22	2	19	24
37	14	44	42	19	15	3	39	19	15	22	21	18	23
38	14	45	1	19	15	3	58	19	15	22	39	19	22
39	14	45	20	19	15	4	17	18	15	22	58	19	21
40	14	45	39	19	15	4	35	19	15	23	17	18	20
41	14	45	58	19	15	4	54	19	15	23	35	19	19
42	14	46	17	19	15	5	13	19	15	23	54	18	18
43	14	46	36	19	15	5	32	19	15	24	12	19	17
44	14	46	55	19	15	5	51	18	15	24	31	18	16
45	14	47	14	19	15	6	9	19	15	24	49	19	15
46	14	47	33	19	15	6	28	19	15	25	8	18	14
47	14	47	52	19	15	6	47	19	15	25	26	19	13
48	14	48	11	19	15	7	6	19	15	25	45	18	12
49	14	48	30	19	15	7	25	18	15	26	3	19	11
50	14	48	49	19	15	7	43	19	15	26	22	18	10
51	14	49	8	20	15	8	2	19	15	26	40	19	9
52	14	49	28	19	15	8	21	19	15	26	59	18	8
53	14	49	47	19	15	8	40	18	15	27	17	19	7
54	14	50	6	19	15	8	58	19	15	27	36	18	6
55	14	50	25	19	15	9	17	19	15	27	54	19	5
56	14	50	44	19	15	9	36	19	15	28	13	18	4
57	14	51	3	19	15	9	55	18	15	28	31	19	3
58	14	51	22	19	15	10	13	19	15	28	50	18	2
59	14	51	41	18	15	10	32	19	15	29	8	19	1
60	14	51	59	19	15	10	51	19	15	29	27	18	0
		20				19				18			

	12			dif.	13			dif.	14			dif	
mi.	*Deg.*	*Mi.*	*Se*	*Se*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se*	*mi.*
0	15	29	27	18	15	47	47	18	16	5	51	18	60
1	15	29	45	19	15	48	5	18	16	6	9	18	59
2	15	30	4	18	15	48	23	18	16	6	27	18	58
3	15	30	22	19	15	48	41	19	16	6	45	18	57
4	15	30	41	18	15	49	0	18	16	7	3	18	56
5	15	30	59	18	15	49	18	18	16	7	21	19	55
6	15	31	17	19	15	49	36	18	16	7	38	18	54
7	15	31	36	18	15	45	54	18	16	7	56	18	53
8	15	31	54	19	15	50	12	19	16	8	14	18	52
9	15	32	13	18	15	50	31	18	16	8	32	18	51
10	15	32	31	19	15	50	49	18	16	8	50	18	50
11	15	32	50	18	15	51	7	18	16	9	8	18	49
12	15	33	8	18	15	51	25	18	16	9	26	18	48
13	15	33	26	19	15	51	43	18	16	9	44	17	47
14	15	33	45	18	15	52	1	18	16	10	1	18	46
15	15	34	3	19	15	52	19	19	16	10	19	18	45
16	15	34	22	18	15	52	38	18	16	10	37	18	44
17	15	34	40	18	15	52	56	18	16	10	55	18	43
18	15	34	48	19	15	53	14	18	16	11	13	18	42
19	15	35	17	18	15	53	32	18	16	11	31	18	41
20	15	35	35	19	15	53	50	18	16	11	49	17	40
21	15	35	54	18	15	54	8	18	16	12	6	18	39
22	15	36	12	18	15	54	26	18	16	12	24	18	38
23	15	36	30	19	15	54	44	18	16	12	42	18	37
24	15	36	49	18	15	55	2	19	16	13	0	18	36
25	15	37	7	18	15	55	21	18	16	13	18	18	35
26	15	37	25	19	15	55	39	18	16	13	36	17	34
27	15	37	44	18	15	55	57	18	16	13	53	18	33
28	15	38	2	18	15	56	15	18	16	14	11	18	32
29	15	38	20	19	15	56	33	18	16	14	29	18	31
30	15	38	39	18	15	56	51	18	16	14	47	18	30
		17				16				15			

	12		dif.	13		dif.	14		dif.	
mi.	Deg.	Mi. Se.	Se.	Deg.	Mi. Se.	Se.	Deg.	Mi. Se.	Se.	mi.
30	15	38 39	18	15	56 51	18	16	14 47	18	30
31	15	38 57	18	15	57 9	18	16	15 5	17	29
32	15	39 15	19	15	57 27	18	16	15 22	18	28
33	15	39 34	18	15	57 45	18	16	15 40	18	27
34	15	39 52	18	15	58 3	18	16	15 58	18	26
35	15	40 10	19	15	58 31	18	16	16 16	17	25
36	15	40 29	18	15	58 39	18	16	16 33	18	24
37	15	40 47	18	15	58 57	18	16	16 51	18	23
38	15	41 5	19	15	59 15	18	16	17 9	18	22
39	15	41 24	18	15	59 33	18	16	17 27	17	21
40	15	41 42	18	15	59 51	18	16	17 44	18	20
41	15	42 0	19	16	0 9	18	16	18 2	18	19
42	15	42 19	18	16	0 27	18	16	18 20	18	18
43	15	42 37	18	16	0 45	18	16	18 38	17	17
44	15	42 55	18	16	1 3	18	16	18 55	18	16
45	15	43 13	19	16	1 21	18	16	19 13	18	15
46	15	43 32	18	16	1 39	18	16	19 31	18	14
47	15	43 50	18	16	1 57	18	16	19 49	17	13
48	15	44 8	18	16	2 15	18	16	20 6	18	12
49	15	44 26	19	16	2 33	18	16	20 24	18	11
50	15	44 45	18	16	2 51	18	16	20 42	17	10
51	15	45 3	18	16	3 9	18	16	20 59	18	9
52	15	45 21	18	16	3 27	18	16	21 17	18	8
53	15	45 39	19	16	3 45	18	16	21 35	17	7
54	15	45 58	18	16	4 3	18	16	21 52	18	6
55	15	46 16	18	16	4 21	18	16	22 10	18	5
56	15	46 34	18	16	4 39	18	16	22 28	17	4
57	15	46 52	18	16	4 57	18	16	22 45	18	3
58	15	47 10	19	16	5 15	18	16	23 3	18	2
59	15	47 29	18	16	5 33	18	16	23 21	17	1
60	15	47 47	18	16	5 51	18	16	23 38	18	0
		17			16			15		

	15			dif.	16			dif.	17			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*mi.*
0	16	23	38	18	16	41	9	17	16	58	22	17	60
1	16	23	56	18	16	41	26	18	16	58	39	18	59
2	16	24	14	17	16	41	44	17	16	58	57	17	58
3	16	24	31	18	16	42	1	17	16	59	14	17	57
4	16	24	49	18	16	42	18	18	16	59	31	17	56
5	16	25	7	17	16	42	36	17	16	59	48	17	55
6	16	25	24	18	16	42	53	17	17	0	5	17	54
7	16	25	42	17	16	43	10	18	17	0	22	17	53
8	16	25	59	18	16	43	28	17	17	0	39	17	52
9	16	26	17	18	16	43	45	17	17	0	56	17	51
10	16	26	35	17	16	44	2	18	17	1	13	17	50
11	16	26	52	18	16	44	20	17	17	1	30	17	49
12	16	27	10	18	16	44	37	17	17	1	47	17	48
13	16	27	28	17	16	44	54	18	17	2	4	17	47
14	16	27	45	18	16	45	12	17	17	2	21	17	46
15	16	28	3	17	16	45	29	17	17	2	38	17	45
16	16	28	20	18	16	45	46	18	17	2	55	17	44
17	16	28	38	17	16	46	4	17	17	3	12	17	43
18	16	28	55	18	16	46	21	17	17	3	29	17	42
19	16	29	13	18	16	46	38	17	17	3	46	17	41
20	16	29	31	17	16	46	55	18	17	4	3	17	40
21	16	29	48	18	16	47	13	17	17	4	20	17	39
22	16	30	6	17	16	47	30	17	17	4	37	17	38
23	16	30	23	18	16	47	47	17	17	4	54	17	37
24	16	30	41	17	16	48	4	18	17	5	11	17	36
25	16	30	58	18	16	48	22	17	17	5	28	17	35
26	16	31	16	17	16	48	39	17	17	5	45	17	34
27	16	31	33	18	16	48	56	17	17	6	2	17	33
28	16	31	51	17	16	49	13	18	17	6	19	17	32
29	16	32	8	18	16	49	31	17	17	6	36	17	31
30	16	32	26	17	16	49	48	17	17	6	53	16	30
		14				13				12			

Leo. Aquarius.

	15			dif.	16			dif.	17			dif	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
30	16	32	26	17	16	49	48	17	17	6	53	16	30
31	16	32	43	18	16	50	5	17	17	7	9	17	29
32	16	33	1	17	16	50	22	18	17	7	26	17	28
33	16	33	18	18	16	50	40	17	17	7	43	17	27
34	16	33	36	17	16	50	57	17	17	8	0	17	26
35	16	33	53	18	16	51	14	17	17	8	17	17	25
36	16	34	11	17	16	51	31	17	17	8	34	17	24
37	16	34	24	18	16	51	48	18	17	8	51	17	23
38	16	34	46	17	16	52	6	17	17	9	8	17	22
39	16	35	3	18	16	52	23	17	17	9	25	17	21
40	16	35	21	17	16	52	40	17	17	9	42	16	20
41	16	35	38	18	16	52	57	17	17	9	58	17	19
42	16	35	56	17	16	53	14	17	17	10	15	17	18
43	16	36	13	18	16	53	31	18	17	10	32	17	17
44	16	36	31	17	16	53	49	17	17	10	49	17	16
45	16	36	48	18	16	54	6	17	17	11	6	17	15
46	16	37	6	17	16	54	23	17	17	11	23	17	14
47	16	37	23	17	16	54	40	17	17	11	40	16	13
48	16	37	40	18	16	54	57	17	17	11	56	17	12
49	16	37	58	17	16	55	14	17	17	12	13	17	11
50	16	38	15	18	16	55	31	18	17	12	30	17	10
51	16	38	33	17	16	55	49	17	17	12	47	17	9
52	16	38	50	17	16	56	6	17	17	13	4	17	8
53	16	39	7	18	16	56	23	17	17	13	21	16	7
54	16	39	25	17	16	56	40	17	17	13	37	17	6
55	16	39	42	18	16	56	57	17	17	13	54	17	5
56	16	40	0	17	16	57	14	17	17	14	11	17	4
57	16	40	17	17	16	57	31	17	17	14	28	17	3
58	16	40	34	18	16	57	48	17	17	14	45	16	2
59	16	40	52	17	16	58	5	17	17	15	1	17	1
60	16	41	9	17	16	58	22	17	17	15	18	17	0
		14				13				12			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	17	15	18	17	17	31	56	16	17	48	15	16	60
1	17	15	35	17	17	32	12	17	17	48	31	17	59
2	17	15	52	16	17	32	29	16	17	48	48	16	58
3	17	16	8	17	17	32	45	17	17	49	4	16	57
4	17	16	25	17	17	33	2	16	17	49	20	16	56
5	17	16	42	17	17	33	18	17	17	49	36	16	55
6	17	16	59	16	17	33	35	16	17	49	52	16	54
7	17	17	15	17	17	33	51	17	17	50	8	16	53
8	17	17	32	17	17	34	8	16	17	50	24	17	52
9	17	17	49	17	17	34	24	16	17	50	41	16	51
10	17	18	6	16	17	34	40	17	17	50	57	16	50
11	17	18	22	17	17	34	57	16	17	51	13	16	49
12	17	18	39	17	17	35	13	17	17	51	29	16	48
13	17	18	56	16	17	35	30	16	17	51	45	16	47
14	17	19	12	17	17	35	46	17	17	52	1	16	46
15	17	19	29	17	17	36	3	16	17	52	17	16	45
16	17	19	46	17	17	36	19	16	17	52	33	16	44
17	17	20	3	16	17	36	35	17	17	52	49	17	43
18	17	20	19	17	17	36	52	16	17	53	6	16	42
19	17	20	36	17	17	37	8	16	17	53	22	16	41
20	17	20	53	16	17	37	24	17	17	53	38	16	40
21	17	21	9	17	17	37	41	16	17	53	54	16	39
22	17	21	26	17	17	37	57	17	17	54	10	16	38
23	17	21	43	16	17	38	14	16	17	54	26	16	37
24	17	21	59	17	17	38	30	16	17	54	42	16	36
25	17	22	16	17	17	38	46	17	17	54	58	16	35
26	17	22	33	16	17	39	3	16	17	55	14	16	34
27	17	22	49	17	17	39	39	16	17	55	30	16	33
28	17	23	6	17	17	39	35	17	17	56	46	16	32
29	17	23	3	16	17	39	52	16	17	56	2	16	31
30	17	23	39	17	17	40	8	16	17	56	18	16	30
		11				10				9			

	18			dif.	19			dif.	20			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*mi.*
30	17	23	39	17	17	40	8	16	17	56	18	16	30
31	17	23	56	17	17	40	24	17	17	56	34	16	29
32	17	24	13	16	17	40	41	16	17	56	50	16	28
33	17	24	29	17	17	40	57	16	17	57	6	16	27
34	17	24	46	16	17	41	13	16	17	57	22	16	26
35	17	25	2	17	17	41	29	17	17	57	38	16	25
36	17	25	19	17	17	41	46	16	17	57	54	16	24
37	17	25	36	16	17	42	2	16	17	58	10	16	23
38	17	25	52	17	17	42	18	17	17	58	26	16	22
39	17	26	9	16	17	42	35	16	17	58	42	16	21
40	17	26	25	17	17	42	51	16	17	58	58	16	20
41	17	26	42	17	17	43	7	16	17	59	14	16	19
42	17	26	59	16	17	43	23	17	17	59	30	16	18
43	17	27	15	17	17	43	40	16	17	59	46	16	17
44	17	27	32	16	17	43	56	16	18	0	2	16	16
45	17	27	48	17	17	44	12	16	18	0	18	16	15
46	17	28	5	16	17	44	28	17	18	0	34	16	14
47	17	28	21	17	17	44	45	16	18	0	50	15	13
48	17	28	38	16	17	45	1	16	18	1	5	16	12
49	17	28	54	17	17	45	17	16	18	1	21	16	11
50	17	29	11	16	17	45	33	17	18	1	37	16	10
51	17	29	27	17	17	45	50	16	18	1	53	16	9
52	17	29	44	16	17	46	6	16	18	2	9	16	8
53	17	30	0	17	17	46	22	16	18	2	25	16	7
54	17	30	17	16	17	46	38	16	18	2	41	16	6
55	17	30	33	17	17	46	54	17	18	2	57	16	5
56	17	30	50	16	17	47	11	16	18	3	13	15	4
57	17	31	6	17	17	47	27	16	18	3	28	16	3
58	17	31	23	16	17	47	43	16	18	3	44	16	2
59	17	31	39	17	17	47	59	16	18	4	0	16	1
60	17	31	56	16	17	48	15	16	18	4	16	16	0
		11				10				9			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	18	4	16	16	18	19	58	15	18	35	20	15	60
1	18	4	32	16	18	20	13	16	18	35	35	15	59
2	18	4	48	16	18	20	29	15	18	35	50	15	58
3	18	5	4	15	18	20	44	16	18	36	5	16	57
4	18	5	19	16	18	21	0	15	18	36	21	15	56
5	18	5	35	16	18	21	15	16	18	36	36	15	55
6	18	5	51	16	18	21	31	15	18	36	51	15	54
7	18	6	7	16	18	21	46	16	18	37	6	15	53
8	18	6	23	15	18	22	2	15	18	37	21	15	52
9	18	6	38	16	18	22	17	16	18	37	36	16	51
10	18	6	54	16	18	22	33	15	18	37	52	15	50
11	18	7	10	16	18	22	48	16	18	38	7	15	49
12	18	7	26	16	18	23	4	15	18	38	22	15	48
13	18	7	42	15	18	23	19	16	18	38	37	15	47
14	18	7	57	16	18	23	35	15	18	38	52	15	46
15	18	8	13	16	18	23	50	15	18	39	7	15	45
16	18	8	29	16	18	24	5	16	18	39	22	16	44
17	18	8	45	15	18	24	21	15	18	39	38	15	43
18	18	9	0	16	18	24	36	16	18	39	53	15	42
19	18	9	16	16	18	24	52	15	18	40	8	15	41
20	18	9	32	16	18	25	7	16	18	40	23	15	40
21	18	9	48	15	18	25	23	15	18	40	38	15	39
22	18	10	3	16	18	25	38	15	18	40	53	15	38
23	18	10	19	16	18	25	53	16	18	41	8	15	37
24	18	10	35	16	18	26	9	15	18	41	25	15	36
25	18	10	51	15	18	26	24	16	18	41	38	15	35
26	18	11	6	16	18	26	50	15	18	41	53	15	34
27	18	11	22	16	18	26	55	15	18	42	8	15	33
28	18	11	38	16	18	27	10	16	18	42	23	15	32
29	18	11	54	15	18	27	26	15	18	42	38	16	31
30	18	12	9	16	18	27	41	16	18	42	54	15	30
		8				7				6			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	18	12	9	16	18	27	41	16	18	42	54	15	30
31	18	12	25	16	18	27	57	15	18	43	9	15	29
32	18	12	41	15	18	28	12	15	18	43	24	15	28
33	18	12	56	16	18	28	27	16	18	43	39	15	27
34	18	13	12	16	18	28	43	15	18	43	54	15	26
35	18	13	28	15	18	28	58	15	18	44	9	15	25
36	18	13	43	16	18	29	13	16	18	44	24	15	24
37	18	13	59	16	18	29	29	15	18	44	39	15	23
38	18	14	15	15	18	29	44	15	18	44	54	15	22
39	18	14	30	16	18	29	59	16	18	45	9	15	21
40	18	14	46	16	18	30	15	15	18	45	24	15	20
41	18	15	2	15	18	30	30	15	18	45	39	15	19
42	18	15	17	16	18	30	45	16	18	45	54	15	18
43	18	15	33	15	18	31	1	15	18	46	9	15	17
44	18	15	48	16	18	31	16	15	18	46	24	14	16
45	18	16	4	16	18	31	31	15	18	46	38	15	15
46	18	16	20	15	18	31	46	16	18	46	53	15	14
47	18	16	35	16	18	32	2	15	18	47	8	15	13
48	18	16	51	15	18	32	17	15	18	47	23	15	12
49	18	17	6	16	18	32	32	15	18	47	38	15	11
50	18	17	22	16	18	32	47	16	18	47	53	15	10
51	18	17	38	15	18	33	3	15	18	48	8	15	9
52	18	17	53	16	18	33	18	15	18	48	23	15	8
53	18	18	9	15	18	33	33	15	18	48	38	15	7
54	18	18	24	16	18	33	48	16	18	48	53	15	6
55	18	18	40	15	18	34	4	15	18	49	8	15	5
56	18	18	55	16	18	34	19	15	18	49	23	15	4
57	18	19	11	16	18	34	34	15	18	49	38	14	3
58	18	19	27	15	18	34	49	16	18	49	52	15	2
59	18	19	42	16	18	35	5	15	18	50	7	15	1
60	18	19	58	15	18	35	20	15	18	50	22	15	0
		8				7				6			

	24			dif.	25			dif.	26			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	18	50	22	15	19	5	5	14	19	19	26	15	60
1	18	50	37	15	19	5	19	15	19	19	41	14	59
2	18	50	52	15	19	5	34	14	19	19	55	14	58
3	18	51	7	15	19	5	48	15	19	20	9	14	57
4	18	51	22	15	19	6	3	14	19	20	23	14	56
5	18	51	37	14	19	6	17	15	19	20	37	14	55
6	18	51	51	15	19	6	32	14	19	20	51	15	54
7	18	52	6	15	19	6	46	15	19	21	6	14	53
8	18	52	21	15	19	7	1	14	19	21	20	14	52
9	18	52	36	15	19	7	15	15	19	21	34	14	51
10	18	52	51	55	19	7	30	14	19	21	48	14	50
11	18	53	6	14	19	7	44	15	19	22	2	14	49
12	18	53	20	15	19	7	59	14	19	22	16	14	48
13	18	53	35	15	19	8	13	14	19	22	30	14	47
14	18	53	50	15	19	8	27	15	19	22	44	15	46
15	18	54	5	15	19	8	42	14	19	22	59	14	45
16	18	54	20	14	19	8	56	15	19	23	13	14	44
17	18	54	34	15	19	9	11	14	19	23	27	14	43
18	18	54	49	15	19	9	25	15	19	24	41	14	42
19	18	55	4	15	19	9	40	14	19	23	55	14	41
20	18	55	19	14	19	9	54	15	19	24	9	14	40
21	18	55	33	15	19	10	9	14	19	24	23	14	39
22	18	55	48	15	19	10	23	14	19	24	37	14	38
23	18	56	3	15	19	10	37	15	19	24	51	14	37
24	18	56	18	14	19	10	52	14	19	25	5	14	36
25	18	56	32	15	19	11	6	15	19	25	19	14	35
26	18	56	47	15	19	11	21	14	19	25	33	14	34
27	18	57	2	15	19	11	35	14	19	25	47	14	33
28	18	57	17	14	19	11	49	15	19	26	1	14	32
29	18	57	31	15	19	12	4	14	19	26	15	15	31
30	18	57	46	15	19	12	18	14	19	26	30	14	30
		5				4				3			

	24			dif.	25			dif.	26			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	18	57	46	15	19	12	18	14	19	26	30	14	30
31	18	58	1	14	19	12	32	15	19	26	44	14	29
32	18	58	15	15	19	12	47	14	19	26	58	14	28
33	18	58	30	15	19	13	1	14	19	27	12	14	27
34	18	58	45	14	19	13	15	15	19	27	26	14	26
35	18	58	59	15	19	13	30	14	19	27	40	14	25
36	18	59	14	15	19	13	44	14	19	27	54	13	24
37	18	59	29	14	19	13	58	15	19	28	7	14	23
38	18	59	43	15	19	14	13	14	19	28	21	14	22
39	18	59	58	15	19	14	27	14	19	28	35	14	21
40	19	0	13	14	19	14	41	15	19	28	49	14	20
41	19	0	27	15	19	14	56	14	19	29	3	14	19
42	19	0	42	15	19	15	10	14	19	29	17	14	18
43	19	0	57	14	19	15	24	15	19	29	31	14	17
44	19	1	11	15	19	15	39	14	19	29	45	14	16
45	19	1	26	15	19	15	53	14	19	29	59	14	15
46	19	1	41	14	19	16	7	14	19	30	13	14	14
47	19	1	55	15	19	16	21	15	19	30	27	14	13
48	19	2	10	14	19	16	36	14	19	30	41	14	12
49	19	2	24	15	19	16	50	14	19	30	55	14	11
50	19	2	39	14	19	17	4	14	19	31	9	14	10
51	19	2	53	15	19	17	18	15	19	31	23	13	9
52	19	3	8	15	19	17	33	14	19	31	36	14	8
53	19	3	23	14	19	17	47	14	19	31	50	14	7
54	19	3	37	15	19	18	1	14	19	32	4	14	6
55	19	3	52	14	19	18	15	15	19	32	18	14	5
56	19	4	6	15	19	18	30	14	19	32	32	14	4
57	19	4	21	14	19	18	44	14	19	32	46	14	3
58	19	4	35	15	19	18	58	14	19	33	0	14	2
59	19	4	50	15	19	19	12	14	19	33	14	13	1
60	19	5	5	14	19	19	26	15	19	33	27	14	0
		5				4				3			

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	19	33	27	14	19	47	7	14	20	0	26	13	60
1	19	33	41	14	19	47	21	13	20	0	39	13	59
2	19	33	55	14	19	47	34	14	20	0	52	13	58
3	19	34	9	14	19	47	48	13	20	1	5	13	57
4	19	34	23	14	19	48	1	14	20	1	18	13	56
5	19	34	37	13	19	48	15	13	20	1	31	13	55
6	19	34	50	14	19	48	28	14	20	1	44	14	54
7	19	35	4	14	19	48	42	13	20	1	58	13	53
8	19	35	18	14	19	48	55	13	20	2	11	13	52
9	19	35	32	14	19	49	8	14	20	2	24	13	51
10	19	35	46	13	19	49	22	13	20	2	37	13	50
11	19	35	59	14	19	49	35	14	20	2	50	13	49
12	19	36	13	14	19	49	49	13	20	3	3	13	48
13	19	36	27	14	19	50	2	14	20	3	16	13	47
14	19	36	41	13	19	50	16	13	20	3	29	13	46
15	19	36	54	14	19	50	29	13	20	3	42	13	45
16	19	37	8	14	19	50	42	14	20	3	55	13	44
17	19	37	22	14	19	50	56	13	20	4	8	13	43
18	19	37	36	13	19	51	9	14	20	4	21	13	42
19	19	37	49	14	19	51	23	13	20	4	34	13	41
20	19	38	3	14	19	51	36	13	20	4	47	13	40
21	19	38	17	14	19	51	49	14	20	5	0	13	39
22	19	38	31	13	19	52	3	13	20	5	13	13	38
23	19	38	44	14	19	52	16	13	20	5	26	13	37
24	19	38	58	14	19	52	29	14	20	5	39	13	36
25	19	39	12	13	19	52	43	13	20	5	52	13	35
26	19	39	25	14	19	52	56	13	20	6	5	13	34
27	19	39	39	14	19	53	9	14	20	6	18	13	33
28	19	39	53	13	19	53	23	13	20	6	31	13	32
29	19	40	6	14	19	53	36	13	20	6	44	13	31
30	19	40	20	14	19	53	49	14	20	6	57	13	30
		2				1				0			

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	19	40	20	14	19	53	49	14	20	6	57	13	30
31	19	40	34	13	19	54	3	13	20	7	10	13	29
32	19	40	47	14	19	54	16	13	20	7	23	13	28
33	19	41	1	14	19	54	29	13	20	7	36	13	27
34	19	41	15	13	19	54	42	14	20	7	49	13	26
35	19	41	28	14	19	54	56	13	20	8	2	12	25
36	19	41	42	14	19	55	9	13	20	8	14	13	24
37	19	41	56	13	19	55	22	14	20	8	27	13	23
38	19	42	9	14	19	55	36	13	20	8	40	13	22
39	19	42	23	13	19	55	49	13	20	8	53	13	21
40	19	42	36	14	19	56	2	13	20	9	6	13	20
41	19	42	50	14	19	56	15	14	20	9	19	13	19
42	19	43	4	13	19	56	29	13	20	9	32	13	18
43	19	43	17	14	19	56	42	13	20	9	45	12	17
44	19	43	31	13	19	56	55	13	20	9	57	13	16
45	19	43	44	14	19	57	8	13	20	10	10	13	15
46	19	43	58	13	19	57	21	14	20	10	23	13	14
47	19	44	11	14	19	57	35	13	20	10	36	13	13
48	19	44	25	14	19	57	48	13	20	10	49	13	12
49	19	44	39	13	19	58	1	13	20	11	2	13	11
50	19	44	52	14	19	58	14	13	20	11	15	12	10
51	19	45	6	13	19	58	27	14	20	11	27	13	9
52	19	45	19	14	19	58	41	13	20	11	40	13	8
53	19	45	33	13	19	58	54	13	20	11	53	13	7
54	19	45	46	14	19	59	7	13	20	12	6	13	6
55	19	46	0	13	19	59	20	13	20	12	19	12	5
56	19	46	13	14	19	59	33	13	20	12	31	13	4
57	19	46	27	13	19	59	46	14	20	12	44	13	3
58	19	46	40	14	20	0	0	13	20	12	57	13	2
59	19	46	54	13	20	0	13	13	20	13	10	12	1
60	19	47	7	14	20	0	26	13	20	13	22	13	0
		1				1				0			

	0	dif.	1	dif.	2	dif.	
mi.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
0	20 13 22	13	20 25 57	12	20 38 9	12	60
1	20 13 35	13	20 26 9	13	20 38 21	12	59
2	20 13 48	13	20 26 22	12	20 38 33	12	58
3	20 14 1	12	20 26 34	13	20 38 45	12	57
4	20 14 13	13	20 26 47	12	20 38 57	12	56
5	20 14 26	13	20 26 59	12	20 39 9	12	55
6	20 14 39	13	20 27 11	13	20 39 21	12	54
7	20 14 52	12	20 27 24	12	20 39 33	12	53
8	20 15 4	13	20 27 36	12	20 39 45	12	52
9	20 15 17	13	20 27 48	13	20 39 57	12	51
10	20 15 30	12	20 28 1	12	20 40 9	12	50
11	20 15 42	13	20 28 13	12	20 40 21	12	49
12	20 15 55	13	20 28 25	13	20 40 33	12	48
13	20 16 8	13	20 28 38	12	20 40 45	12	47
14	20 16 21	12	20 28 50	12	20 40 57	12	46
15	20 16 33	13	20 29 2	12	20 41 9	12	45
16	20 16 46	13	20 29 14	13	20 41 21	11	44
17	20 16 59	12	20 29 27	12	20 41 32	12	43
18	20 17 11	13	20 29 39	12	20 41 48	12	42
19	20 17 24	12	20 29 51	13	20 41 56	12	41
20	20 17 36	13	20 30 4	12	20 42 8	12	40
21	20 17 49	13	20 30 16	12	20 42 20	12	39
22	20 18 2	12	20 30 28	12	20 42 32	12	38
23	20 18 14	13	20 30 40	13	20 42 44	12	37
24	20 18 27	13	20 30 53	12	20 42 56	12	36
25	20 18 40	12	20 31 5	12	20 43 8	13	35
26	20 18 52	13	20 31 17	12	20 43 19	12	34
27	20 19 5	12	20 31 29	12	20 43 31	12	33
28	20 19 17	13	20 31 41	13	20 43 43	12	32
29	20 19 30	13	20 31 54	12	20 43 55	12	31
30	20 19 43	12	20 32 6	12	20 44 7	12	30
	29		28		27		

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	20	19	43	12	20	32	6	12	20	44	7	12	30
31	20	19	55	13	20	32	18	12	20	44	19	11	29
32	20	20	8	12	20	32	30	12	20	44	30	12	28
33	20	20	20	13	20	32	42	13	20	44	42	12	27
34	20	20	33	12	20	32	55	12	20	44	54	12	26
35	20	20	45	13	20	33	7	12	20	45	6	12	25
36	20	20	58	12	20	33	19	12	20	45	18	11	24
37	20	21	10	13	20	33	31	12	20	45	29	12	23
38	20	21	23	12	20	33	43	12	20	45	41	12	22
39	20	21	35	13	20	33	55	13	20	45	53	12	21
40	20	21	48	12	20	34	8	12	20	46	5	11	20
41	20	22	0	13	20	34	20	12	20	46	16	12	19
42	20	22	13	12	20	34	32	12	20	46	28	12	18
43	20	22	25	13	20	34	44	12	20	46	40	12	17
44	20	22	38	12	20	34	56	12	20	46	52	11	16
45	20	22	50	13	20	35	8	12	20	47	3	12	15
46	20	23	3	12	20	35	2	12	20	47	15	12	14
47	20	23	15	13	20	35	32	13	20	47	27	12	13
48	20	23	28	12	20	35	45	12	20	47	39	11	12
49	20	24	40	13	20	35	57	12	20	47	50	12	11
50	20	24	53	12	20	36	9	12	20	48	2	12	10
51	20	24	5	13	20	36	21	12	20	48	14	11	9
52	20	24	18	12	20	36	33	12	20	48	25	12	8
53	20	24	30	13	20	36	45	12	20	48	37	12	7
54	20	24	43	12	20	36	57	12	20	48	49	11	6
55	20	24	55	12	20	37	9	12	20	49	0	12	5
56	20	25	7	13	20	37	21	12	20	49	12	12	4
57	20	25	20	12	20	37	33	12	20	49	24	11	3
58	20	25	32	13	20	37	45	12	20	49	35	12	2
59	20	25	45	12	20	37	57	12	20	49	47	12	1
60	20	25	57	12	20	38	9	12	20	49	59	11	0
		29				28				27			

	3	dif.	4	dif.	5	dif.	
mi.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
0	20 49 59	11	21 1 25	11	21 12 28	11	60
1	20 50 10	12	21 1 36	12	21 12 39	11	59
2	20 50 22	11	21 1 48	11	21 12 50	11	58
3	20 50 33	11	21 1 59	11	21 13 1	11	57
4	20 50 45	12	21 2 10	11	21 13 12	10	56
5	20 50 57	11	21 2 21	11	21 13 22	11	55
6	20 51 8	12	21 2 32	12	21 13 33	11	54
7	20 51 20	11	21 2 44	11	21 13 44	11	53
8	20 51 31	12	21 2 55	11	21 13 55	11	52
9	20 51 43	12	21 3 6	11	21 14 6	10	51
10	20 51 55	11	21 3 17	11	21 14 16	11	50
11	20 52 6	12	21 3 28	12	21 14 27	11	49
12	20 52 18	11	21 3 40	11	21 14 38	11	48
13	20 52 29	12	21 3 51	11	21 14 49	11	47
14	20 52 41	11	21 4 2	11	21 15 0	10	46
15	20 52 52	12	21 4 13	11	21 15 10	11	45
16	20 53 4	11	21 4 24	11	21 15 21	11	44
17	20 53 15	12	21 4 35	11	21 15 32	11	43
18	20 53 27	11	21 4 46	12	21 15 43	10	42
19	20 53 38	12	21 4 58	11	21 15 53	11	41
20	20 53 50	11	21 5 9	11	21 16 4	11	40
21	20 54 1	12	21 5 20	11	21 16 15	10	39
22	20 54 13	11	21 5 31	11	21 16 25	11	38
23	20 54 24	12	21 5 42	11	21 16 36	11	37
24	20 54 36	11	21 5 53	11	21 16 47	11	36
25	20 54 47	12	21 6 4	11	21 16 58	10	35
26	20 54 59	11	21 6 15	11	21 17 8	11	34
27	20 55 10	12	21 6 26	11	21 17 19	11	33
28	20 55 22	11	21 6 37	11	21 17 30	10	32
29	20 55 33	12	21 6 48	12	21 17 40	11	31
30	20 55 45	11	21 7 0	11	21 17 51	11	30
	26		25		24		

	3			dif.	4			dif.	5			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	20	55	45	11	21	7	0	11	21	17	51	11	30
31	20	55	56	12	21	7	11	11	21	18	2	10	29
32	20	56	8	11	21	7	22	11	21	18	12	11	28
33	20	56	19	11	21	7	33	11	21	18	23	10	27
34	20	56	30	12	21	7	44	11	21	18	33	11	26
35	20	56	42	11	21	7	55	11	21	18	44	11	25
36	20	56	53	12	21	8	6	11	21	18	55	10	24
37	20	57	5	11	21	8	17	11	21	19	5	11	23
38	20	57	16	11	21	8	28	11	21	19	16	11	22
39	20	57	27	12	21	8	39	11	21	19	27	10	21
40	20	57	39	11	21	8	50	11	21	19	37	11	20
41	20	57	50	12	21	9	1	11	21	19	48	10	19
42	20	58	2	11	21	9	12	11	21	19	58	11	18
43	20	58	13	11	21	9	23	11	21	20	9	11	17
44	20	58	24	12	21	9	34	11	21	20	20	10	16
45	20	58	36	11	21	9	45	11	21	20	30	11	15
46	20	58	47	11	21	9	56	11	21	20	41	10	14
47	20	58	58	12	21	10	7	10	21	20	51	11	13
48	20	59	10	11	21	10	17	11	21	21	2	10	12
49	20	59	21	11	21	10	28	11	21	21	12	11	11
50	20	59	32	12	21	10	39	11	21	21	23	10	10
51	20	59	44	11	21	10	50	11	21	21	33	11	9
52	20	59	55	11	21	11	1	11	21	21	44	10	8
53	21	0	6	11	21	11	12	11	21	21	54	11	7
54	21	0	17	12	21	11	23	11	21	22	5	10	6
55	21	0	29	11	21	11	34	11	21	22	15	11	5
56	21	0	40	11	21	11	45	11	21	22	26	10	4
57	21	0	51	12	21	11	56	10	21	22	36	11	3
58	21	1	3	11	21	12	6	11	21	22	47	10	2
59	21	1	14	11	21	12	17	11	21	22	57	11	1
60	21	1	25	11	21	12	28	11	21	23	8	10	0
		26				25				24			

	6			dif.	7			dif.	8			dif	
mi.	Deg.	Mi.	Se.	Se	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
0	21	23	8	10	21	33	23	10	21	43	15	10	60
1	21	23	18	11	21	33	33	11	21	43	25	9	59
2	21	23	29	10	21	33	44	10	21	43	34	10	58
3	21	23	39	11	21	33	54	10	21	43	44	10	57
4	21	23	50	10	21	34	4	10	21	43	54	9	56
5	21	24	0	10	21	34	14	10	21	44	3	10	55
6	21	24	10	11	21	34	24	10	21	44	13	9	54
7	21	24	21	10	21	34	34	10	21	44	22	10	53
8	21	24	31	11	21	34	44	10	21	44	32	10	52
9	21	24	42	10	21	34	54	10	21	44	42	9	51
10	21	24	52	11	21	35	4	10	21	44	51	10	50
11	21	25	2	11	21	35	14	10	21	45	1	9	49
12	21	25	13	10	21	35	24	10	21	45	10	10	48
13	21	25	23	11	21	35	34	10	21	45	20	10	47
14	21	25	34	10	21	35	44	10	21	45	30	9	46
15	21	25	44	10	21	35	54	10	21	45	39	10	45
16	21	25	54	11	21	36	4	9	21	45	49	10	44
17	21	26	5	10	21	36	13	10	21	45	59	9	43
18	21	26	15	10	21	36	23	10	21	46	8	9	42
19	21	26	25	11	21	36	33	10	21	46	17	9	41
20	21	26	36	10	21	36	43	10	21	46	26	10	40
21	21	26	46	10	21	36	53	10	21	46	36	10	39
22	21	26	56	11	21	37	3	10	21	46	46	19	38
23	21	27	7	10	21	37	13	10	21	46	55	10	37
24	21	27	17	10	21	37	23	10	21	47	5	9	36
25	21	27	27	10	21	37	33	10	21	47	14	10	35
26	21	27	37	11	21	37	43	10	21	47	24	9	34
27	21	27	48	10	21	37	53	9	21	47	33	10	33
28	21	27	58	10	21	38	2	10	21	47	43	9	32
29	21	28	8	11	21	38	12	10	21	47	52	10	31
30	21	28	19	10	21	38	22	10	21	48	2	9	30
		23				22				21			

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	6			dif.	7			dif.	8			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	21	28	19	10	21	38	22	10	21	48	2	9	30
31	21	28	29	10	21	38	32	10	21	48	11	10	29
32	21	28	39	10	21	38	42	10	11	48	21	9	28
33	21	28	49	9	21	38	52	10	21	48	30	9	27
34	21	29	0	10	21	39	2	9	21	48	39	10	26
35	21	29	10	10	21	39	11	10	21	48	49	9	25
36	21	29	20	10	21	39	21	10	21	48	58	10	24
37	21	29	30	10	21	39	31	10	21	49	8	9	23
38	21	29	40	11	21	39	41	10	21	49	17	9	22
39	21	29	51	10	21	39	51	9	21	49	26	10	21
40	21	30	1	10	21	40	0	10	21	49	36	9	20
41	21	30	11	10	21	40	10	10	21	49	45	10	19
42	21	30	21	10	21	40	20	10	21	49	55	9	18
43	21	30	31	11	21	40	30	10	21	50	4	9	17
44	21	30	42	10	21	40	40	9	21	50	13	10	16
45	21	30	52	10	21	40	49	10	21	50	23	9	15
46	21	31	2	10	21	40	59	10	21	50	32	9	14
47	21	31	12	10	21	41	9	10	21	50	41	10	13
48	21	31	22	10	21	41	19	9	21	50	51	9	12
49	21	31	32	10	21	41	28	10	21	51	0	9	11
50	21	31	42	11	21	41	38	10	21	51	9	10	10
51	21	31	53	10	21	41	48	10	21	51	19	9	9
52	21	32	3	10	21	41	58	9	21	51	28	9	8
53	21	32	13	10	21	42	7	10	21	51	37	10	7
54	21	32	23	10	21	42	17	10	21	51	47	9	6
55	21	32	33	10	21	42	27	9	21	51	56	9	5
56	21	32	43	10	21	42	36	10	21	52	5	9	4
57	21	32	53	10	21	42	46	10	21	52	14	10	3
58	21	33	3	10	21	42	56	9	21	52	24	9	2
59	21	33	13	10	21	43	5	10	21	52	33	9	1
60	21	33	23	10	21	43	15	10	21	52	42	9	0
		23				22				21			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	21	52	42	9	22	1	45	9	22	10	22	9	60
1	21	52	51	10	22	1	54	8	22	10	31	8	59
2	21	53	1	9	22	2	2	9	22	10	39	9	58
3	21	53	10	9	22	2	11	9	22	10	48	8	57
4	21	53	19	9	22	2	20	9	22	10	56	8	56
5	21	53	28	10	22	2	29	9	22	11	4	9	55
6	21	53	38	9	22	2	38	8	22	11	13	8	54
7	21	53	47	9	22	2	46	9	22	11	21	9	53
8	21	53	56	9	22	2	55	9	22	11	30	8	52
9	21	54	5	9	22	3	4	9	22	11	38	8	51
10	21	54	14	10	22	3	13	9	22	11	46	9	50
11	21	54	24	9	22	3	22	8	22	11	55	8	49
12	21	54	33	9	22	3	30	9	22	12	3	8	48
13	21	54	42	9	22	3	39	9	22	12	11	9	47
14	21	54	51	9	22	3	48	9	22	12	20	8	46
15	21	55	0	9	22	3	57	8	22	12	28	8	45
16	21	55	9	9	22	4	5	9	22	12	36	9	44
17	21	55	18	10	22	4	14	9	22	12	45	8	43
18	21	55	28	9	22	4	23	8	22	12	53	8	42
19	21	55	37	9	22	4	31	9	22	13	1	8	41
20	21	55	46	9	22	4	40	9	22	13	9	9	40
21	21	55	55	9	22	4	49	9	22	13	18	8	39
22	21	56	4	9	22	4	58	8	22	13	26	8	38
23	21	56	13	9	22	5	6	9	22	13	34	9	37
24	21	56	22	9	22	5	15	9	22	13	43	8	36
25	21	56	31	9	22	5	24	8	22	13	51	8	35
26	21	56	40	9	22	5	32	9	22	13	59	8	34
27	21	56	49	9	22	5	41	8	22	14	7	8	33
28	21	56	58	10	22	5	49	9	22	14	15	9	32
29	21	57	8	9	22	5	58	9	22	14	24	8	31
30	21	57	17	9	22	6	7	8	22	14	32	8	30
		20				19				18			

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	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	21	57	17	9	22	6	7	8	22	14	32	8	30
31	22	57	26	9	22	6	15	9	22	14	40	8	29
32	21	57	35	9	22	6	24	9	22	14	48	9	28
33	21	57	44	9	22	6	33	8	22	14	57	8	27
34	21	57	53	9	22	6	41	9	22	15	5	8	26
35	21	58	2	9	22	6	50	8	22	15	13	8	25
36	21	58	11	9	22	6	58	9	22	15	21	8	24
37	21	58	20	9	22	7	7	9	22	15	29	8	23
38	21	58	29	9	22	7	16	8	22	15	37	9	22
39	21	58	38	9	22	7	24	9	22	15	46	8	21
40	21	58	47	9	23	7	33	8	22	15	54	8	20
41	21	58	56	9	23	7	41	9	22	16	2	8	19
42	21	59	5	9	23	7	50	8	22	16	10	8	18
43	21	59	14	9	22	7	58	9	22	16	18	8	17
44	21	59	23	8	22	8	7	8	22	16	26	8	16
45	21	59	31	9	22	8	15	9	22	16	34	8	15
46	21	59	40	9	22	8	24	8	22	16	42	8	14
47	21	59	49	9	22	8	32	9	22	16	50	9	13
48	21	59	58	9	22	8	41	8	22	16	59	8	12
49	22	0	7	9	22	8	49	9	22	17	7	8	11
50	22	0	16	9	22	8	58	8	22	17	15	8	10
51	22	0	25	9	22	9	6	9	22	17	23	8	9
52	21	0	34	9	22	9	15	8	22	17	31	8	8
53	21	0	43	9	22	9	23	9	22	17	39	8	7
54	21	0	52	9	22	9	32	8	22	17	47	8	6
55	21	1	1	8	22	9	40	9	22	17	55	8	5
56	21	1	9	9	22	9	49	8	22	18	3	8	4
57	21	1	18	9	22	9	57	9	22	18	11	8	3
58	22	1	27	9	22	10	6	8	22	18	19	8	2
59	22	1	36	9	22	10	14	8	22	18	27	8	1
60	22	1	45	9	22	10	22	9	22	18	35	8	0
		20				19				18			

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se	Deg.	Mi.	Se.	Se.	mi.
0	22	18	35	8	22	26	22	8	22	33	44	7	60
1	22	18	43	8	22	26	30	7	22	33	51	7	59
2	22	18	51	8	22	26	37	8	22	33	58	7	58
3	22	18	59	8	22	26	45	8	22	34	5	8	57
4	22	19	7	8	22	26	53	7	22	34	13	7	56
5	22	19	15	8	22	27	0	8	22	34	20	7	55
6	22	19	23	8	22	27	8	7	22	34	27	7	54
7	22	19	31	8	22	27	15	8	22	34	34	7	53
8	22	19	39	8	22	27	23	7	22	34	41	7	52
9	22	19	47	8	22	27	30	8	22	34	48	7	51
10	22	19	55	8	22	27	38	7	22	34	55	7	50
11	22	20	3	8	22	27	45	8	22	35	2	7	49
12	22	20	11	7	22	27	53	7	22	35	9	7	48
13	22	20	18	8	22	28	0	8	22	35	16	7	47
14	22	20	26	8	22	28	8	7	22	35	23	7	46
15	22	20	34	8	22	28	15	8	22	35	30	8	45
16	22	20	42	8	22	28	23	7	22	35	38	7	44
17	22	20	50	8	22	28	30	8	22	35	45	7	43
18	22	20	58	8	22	28	38	7	22	35	52	7	42
19	22	21	6	8	22	28	45	7	22	35	59	7	41
20	22	21	14	7	22	28	52	8	22	36	6	7	40
21	22	21	21	8	22	29	0	7	22	36	13	7	39
22	22	21	29	8	22	29	7	8	22	36	20	7	38
23	22	21	37	8	22	29	15	7	22	36	27	7	37
24	22	21	45	8	22	29	22	7	22	36	34	7	36
25	22	21	53	8	22	29	29	8	22	36	41	6	35
26	22	22	1	7	22	29	37	7	22	36	47	7	34
27	22	22	8	8	22	29	44	8	22	36	54	7	33
28	22	22	16	8	22	29	52	7	22	37	1	7	32
29	22	22	24	8	22	29	59	7	22	37	8	7	31
30	22	22	32	8	22	30	6	8	22	37	15	7	30
		17				16				15			

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	12			dif.	13			dif.	14			dif.	
m.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	m.
30	22	22	32	8	22	30	6	8	22	37	15	7	30
31	22	22	40	7	22	30	14	7	22	37	22	7	29
32	22	22	47	8	22	30	21	7	22	37	29	7	28
33	22	22	55	8	22	30	28	8	22	37	36	7	27
34	22	23	3	8	22	30	36	7	22	37	43	7	26
35	22	23	11	7	22	30	43	7	22	37	50	7	25
36	22	23	18	8	22	30	50	8	22	37	57	7	24
37	22	23	26	8	22	30	58	7	22	38	4	7	23
38	22	23	34	8	22	31	5	7	22	38	11	6	22
39	22	23	42	7	22	31	12	8	22	38	17	7	21
40	22	23	49	8	22	31	20	7	22	38	24	7	20
41	22	23	57	8	22	31	27	7	22	38	31	7	19
42	22	24	5	7	22	31	34	7	22	38	38	7	18
43	22	24	12	8	22	31	41	8	22	38	45	7	17
44	22	24	20	8	22	31	49	7	22	38	52	6	16
45	22	24	28	8	22	31	56	7	22	38	58	7	15
46	22	24	36	7	22	32	3	8	22	39	5	7	14
47	22	24	43	8	22	32	11	7	22	39	12	7	13
48	22	24	51	8	22	32	18	7	22	39	19	7	12
49	22	24	59	7	22	32	25	7	22	39	26	7	11
50	22	25	6	8	22	32	32	7	22	39	33	6	10
51	22	25	14	7	22	32	39	8	22	39	39	7	9
52	22	25	21	8	22	32	47	7	22	39	46	7	8
53	22	25	29	8	22	32	54	7	22	39	53	7	7
54	22	25	37	7	22	33	1	7	22	40	0	6	6
55	22	25	44	8	22	33	8	7	22	40	6	7	5
56	22	25	52	8	22	33	15	8	22	40	13	7	4
57	22	26	0	7	22	33	23	7	22	40	20	7	3
58	22	26	7	8	22	33	30	7	22	40	27	6	2
59	22	26	15	7	22	33	37	7	22	40	33	7	1
60	22	26	22	8	22	33	44	7	22	40	40	7	0
		17				16				15			

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	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se	Se.	mi.
0	22	40	40	7	22	47	10	6	22	53	14	6	60
1	22	40	47	6	22	47	16	7	22	53	20	6	59
2	22	40	53	7	22	47	23	6	22	53	26	6	58
3	22	41	0	7	22	47	29	6	22	53	32	5	57
4	22	41	7	7	22	47	35	6	22	53	37	6	56
5	22	41	14	6	22	47	41	7	22	53	43	6	55
6	22	41	20	7	22	47	48	6	22	53	49	6	54
7	22	41	27	7	22	47	54	6	22	53	55	6	53
8	22	41	34	6	22	48	0	6	22	54	1	5	52
9	22	41	40	7	22	48	6	7	22	54	6	6	51
10	22	41	47	7	22	48	13	6	22	54	12	6	50
11	22	41	54	6	22	48	19	6	22	54	18	6	49
12	22	42	0	7	22	48	25	6	22	54	24	5	48
13	22	42	7	6	22	48	31	6	22	54	29	6	47
14	22	42	13	7	22	48	37	7	22	54	35	6	46
15	22	42	20	7	22	48	44	6	22	54	41	6	45
16	22	42	27	6	22	48	50	6	22	54	47	5	44
17	22	42	33	7	22	48	56	6	22	54	52	6	43
18	22	42	40	6	22	49	2	6	22	54	58	6	42
19	22	42	46	7	22	49	8	6	22	55	4	6	41
20	22	42	53	7	22	49	14	6	22	55	10	5	40
21	22	43	0	6	22	49	20	7	22	55	15	6	39
22	22	43	6	7	22	49	27	6	22	55	21	6	38
23	22	43	13	6	22	49	33	6	22	55	27	5	37
24	22	43	19	7	22	49	39	6	22	55	32	6	36
25	22	43	26	6	22	49	45	6	22	55	38	6	35
26	22	43	32	7	22	49	51	6	22	55	44	5	34
27	22	43	39	6	22	49	57	6	22	55	49	6	33
28	22	43	45	7	22	50	3	6	22	55	55	6	32
29	22	43	52	6	22	50	9	6	22	56	1	5	31
30	22	43	58	7	22	50	15	6	22	56	6	6	30
		14				13				12			

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	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	22	43	58	7	22	50	15	6	22	56	6	6	30
31	22	44	5	6	22	50	21	6	22	56	12	5	29
32	22	44	11	7	22	50	27	7	22	56	17	6	28
33	22	44	18	6	22	50	34	6	22	56	23	6	27
34	22	44	24	7	22	50	40	6	22	56	29	5	26
35	22	44	31	6	22	50	46	6	22	56	34	6	25
36	22	44	37	7	22	50	52	6	22	56	40	5	24
37	22	44	44	6	22	50	58	6	22	56	45	6	23
38	22	44	50	7	22	51	4	6	22	56	51	6	22
39	22	44	57	6	22	51	10	6	22	56	57	5	21
40	22	45	3	6	22	51	16	6	22	57	2	6	20
41	22	45	9	7	22	51	22	6	22	57	8	5	19
42	22	45	16	6	22	51	28	6	22	57	13	6	18
43	22	45	22	7	22	51	34	6	22	57	19	5	17
44	22	45	29	6	22	51	40	6	22	57	24	6	16
45	22	45	35	6	22	51	46	6	22	57	30	5	15
46	22	45	41	7	22	51	52	5	22	57	35	6	14
47	22	45	48	6	22	51	57	6	22	57	41	5	13
48	22	45	54	7	22	52	3	6	22	57	46	6	12
49	22	46	1	6	22	52	9	6	22	57	52	5	11
50	22	46	7	6	22	52	15	6	22	57	57	6	10
51	22	46	13	7	22	12	21	6	22	58	3	5	9
52	22	46	20	6	22	52	27	6	22	58	8	6	8
53	22	46	26	6	22	52	33	6	22	58	14	5	7
54	22	46	32	7	22	52	39	6	22	58	19	6	6
55	22	46	39	6	22	52	45	6	22	58	25	5	5
56	22	46	45	6	22	52	51	6	22	58	30	6	4
57	22	46	51	7	22	52	57	5	22	58	36	5	3
58	22	46	58	6	22	53	2	6	22	58	41	5	2
59	22	47	4	6	22	53	8	6	22	58	46	6	1
60	22	47	10	6	22	53	14	6	22	58	52	5	0
		14				13				12			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	mi.
0	22	58	52	5	23	4	3	5	23	8	48	4	60
1	22	58	57	6	23	4	8	5	23	8	52	5	59
2	22	59	3	5	23	4	13	5	23	8	57	4	58
3	22	59	8	5	23	4	18	5	23	9	1	5	57
4	22	59	13	6	23	4	23	5	23	9	6	4	56
5	22	59	19	5	23	4	28	5	23	9	10	5	55
6	22	59	24	5	23	4	33	5	23	9	15	4	54
7	22	59	29	6	23	4	38	5	23	9	19	5	53
8	22	59	35	5	23	4	43	4	23	9	24	4	52
9	22	59	40	5	23	4	47	5	23	9	28	5	51
10	22	59	45	6	23	4	52	5	23	9	33	4	50
11	22	59	51	5	23	4	57	5	23	9	37	5	49
12	22	59	56	5	23	5	2	5	23	9	42	4	48
13	23	0	1	6	23	5	7	5	23	9	46	4	47
14	23	0	7	5	23	5	12	5	23	9	50	5	46
15	23	0	12	5	23	5	17	5	23	9	55	4	45
16	23	0	17	6	23	5	22	4	23	9	59	5	44
17	23	0	23	5	23	5	26	5	23	10	4	4	43
18	23	0	28	5	23	5	31	5	23	10	8	4	42
19	23	0	33	5	23	5	36	5	23	10	12	5	41
20	23	0	38	6	23	5	41	5	23	10	17	4	40
21	23	0	44	5	23	5	46	5	23	10	21	4	39
22	23	0	49	5	23	5	51	4	23	10	25	5	38
23	23	0	54	5	23	5	55	5	23	10	30	4	37
24	23	0	59	6	23	6	0	5	23	10	34	5	36
25	23	1	5	5	23	6	5	5	23	10	39	4	35
26	23	1	10	5	23	6	10	4	23	10	43	4	34
27	33	1	15	5	23	6	14	5	23	10	47	5	33
28	23	1	20	5	23	6	19	5	23	10	52	4	32
29	23	1	25	6	23	6	24	5	23	10	56	4	31
30	23	1	31		23	6	29		23	11	0		30
		11				10				9			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	23	1	31	5	23	6	29	4	23	11	0	4	30
31	23	1	36	5	23	6	33	5	23	11	4	5	29
32	23	1	41	5	23	6	38	5	23	11	9	4	28
33	23	1	46	5	23	6	43	5	23	11	13	4	27
34	23	1	51	6	23	6	48	4	23	11	17	5	26
35	23	1	57	5	23	6	52	5	23	11	22	4	25
36	23	2	2	5	23	6	57	5	23	11	26	4	24
37	23	2	7	5	23	7	2	4	23	11	30	4	23
38	23	2	12	5	23	7	6	5	23	11	34	5	22
39	23	2	17	5	23	7	11	5	23	11	39	4	21
40	23	2	22	5	23	7	16	5	23	11	43	4	20
41	23	2	27	5	23	7	21	4	23	11	47	4	19
42	23	2	32	6	23	7	25	5	23	11	51	4	18
43	23	2	38	5	23	7	30	4	23	11	55	5	17
44	23	2	43	5	23	7	34	5	23	12	0	4	16
45	23	2	48	5	23	7	39	5	23	12	4	4	15
46	23	2	53	5	23	7	44	4	23	12	8	4	14
47	23	2	58	5	23	7	48	5	23	12	12	4	13
48	23	3	3	5	23	7	53	5	23	12	16	4	12
49	23	3	8	5	23	7	58	4	23	12	20	5	11
50	23	3	13	5	23	8	2	5	23	12	25	4	10
51	23	3	18	5	23	8	7	4	23	12	29	4	9
52	23	3	23	5	23	8	11	5	23	12	33	4	8
53	23	3	28	5	23	8	16	4	23	12	37	4	7
54	23	3	33	5	23	8	20	5	23	12	41	4	6
55	23	3	38	5	23	8	25	5	23	12	45	4	5
56	23	3	43	5	23	8	30	4	23	12	49	5	4
57	23	3	48	5	23	8	34	5	23	12	54	4	3
58	23	3	53	5	23	8	39	4	23	12	58	4	2
59	23	3	58	5	23	8	43	5	23	13	2	4	1
60	23	4	3		23	8	48		23	13	6		0
		11				10				9			

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	21			dif.	22			dif.	23			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se*	*Se.*	*mi.*
0	23	13	6	4	23	16	57	4	23	20	21	3	60
1	23	13	10	4	23	17	1	3	23	20	24	3	59
2	23	13	14	4	23	17	4	4	23	20	27	4	58
3	23	13	18	4	23	17	8	3	23	20	31	3	57
4	23	13	22	4	23	17	11	4	23	20	34	3	56
5	23	13	26	4	23	17	15	4	23	20	37	3	55
6	23	13	30	4	23	17	19	3	23	20	40	3	54
7	23	13	34	4	23	17	22	4	23	20	43	3	53
8	23	13	38	4	23	17	26	3	23	20	46	3	52
9	23	13	42	4	23	17	29	4	23	20	49	4	51
10	23	13	46	4	23	17	33	3	23	20	53	3	50
11	23	13	50	4	23	17	36	4	23	20	56	3	49
12	23	13	54	4	23	17	40	3	23	20	59	3	48
13	23	13	58	4	23	17	43	4	23	21	2	3	47
14	23	14	2	4	23	17	47	4	23	21	5	3	46
15	23	14	6	4	23	17	51	3	23	21	8	3	45
16	23	14	10	4	23	17	54	4	23	21	11	3	44
17	23	14	14	4	23	17	58	3	23	21	14	3	43
18	23	14	18	4	23	18	1	4	23	21	17	3	42
19	23	14	22	4	23	18	5	3	23	21	20	3	41
20	23	14	26	4	23	18	8	3	23	21	23	3	40
21	23	14	30	4	23	18	11	4	23	21	26	3	39
22	23	14	34	4	23	18	15	3	23	21	29	3	38
23	23	14	38	3	23	18	18	4	23	21	32	3	37
24	23	14	41	4	23	18	22	3	23	21	35	3	36
25	23	14	45	4	23	18	25	4	23	21	38	3	35
26	23	14	49	4	23	18	29	3	23	21	41	3	34
27	33	14	53	4	23	18	32	4	23	21	44	3	33
28	23	14	57	4	23	18	36	3	23	21	47	3	32
29	23	15	1	4	23	18	39	3	23	21	50	3	31
30	23	15	5	4	23	18	42	4	23	21	53	3	30
		8				7				6			

Cancer. Capricorne.

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	23	15	5	4	23	18	42	4	23	21	53	3	30
31	23	15	9	3	23	18	46	3	23	21	56	3	29
32	23	15	12	4	23	18	49	4	23	21	59	3	28
33	23	15	16	4	23	18	53	3	23	22	2	3	27
34	23	15	20	4	23	18	56	3	23	22	5	3	26
35	23	15	24	4	23	18	59	4	23	22	8	3	25
36	23	15	28	4	23	19	3	3	23	22	11	3	24
37	23	15	32	3	23	19	6	3	23	22	14	3	23
38	23	15	35	4	23	19	9	4	23	22	17	2	22
39	23	15	39	4	23	19	13	3	23	22	19	3	21
40	23	15	43	4	23	19	16	3	23	22	22	3	20
41	23	15	47	3	23	19	19	4	23	22	25	3	19
42	23	15	50	4	23	19	23	3	23	22	28	3	18
43	23	15	54	4	23	19	26	3	23	22	31	3	17
44	23	15	58	4	23	19	29	4	23	22	34	3	16
45	23	16	2	3	23	19	33	3	23	22	37	2	15
46	23	16	5	4	23	19	36	3	23	22	39	3	14
47	23	16	9	4	23	19	39	3	23	22	42	3	13
48	23	16	13	4	23	19	42	4	23	22	45	3	12
49	23	16	17	3	23	19	46	3	23	22	48	3	11
50	23	16	20	4	23	19	49	3	23	22	51	2	10
51	23	16	24	4	23	19	52	4	23	22	53	3	9
52	23	16	28	3	23	19	56	3	23	22	56	3	8
53	23	16	31	4	23	19	59	3	23	22	59	3	7
54	23	16	35	4	23	20	2	3	23	23	2	3	6
55	23	16	39	3	23	20	5	3	23	23	5	2	5
56	23	16	42	4	23	20	8	4	23	23	7	3	4
57	23	16	46	4	23	20	12	3	23	23	10	3	3
58	23	16	50	3	23	20	15	3	23	23	13	3	2
59	23	16	53	4	23	20	18	3	23	23	16	2	1
60	23	16	57	4	23	20	21	3	23	23	18	3	0
		8				7				6			

	24			dif.	25			dif.	26			dif	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
0	23	23	18	3	23	25	48	3	23	27	51	2	60
1	23	23	21	3	23	25	51	2	23	27	53	2	59
2	23	23	24	3	23	25	53	2	23	27	55	2	58
3	23	23	27	2	23	25	55	2	23	27	57	2	57
4	23	23	29	3	23	25	57	3	23	27	59	1	56
5	23	23	32	3	23	26	0	2	23	28	0	2	55
6	23	23	35	2	23	26	2	2	23	28	2	2	54
7	23	23	37	3	23	26	4	2	23	28	4	2	53
8	23	23	40	2	23	26	6	3	23	28	6	1	52
9	23	23	42	3	23	26	9	2	23	28	7	2	51
10	23	23	45	3	23	26	11	2	23	28	9	2	50
11	23	23	48	3	23	26	13	2	23	28	11	2	49
12	23	23	51	2	23	26	15	2	23	28	13	1	48
13	23	23	53	3	23	26	17	3	23	28	14	2	47
14	23	23	56	2	23	26	20	2	23	28	16	2	46
15	23	23	58	3	23	26	22	2	23	28	18	2	45
16	23	24	1	3	23	26	24	2	23	28	20	1	44
17	23	24	4	2	23	26	26	2	23	28	21	2	43
18	23	24	6	3	23	26	28	2	23	28	23	2	42
19	23	24	9	2	23	26	30	2	23	28	25	1	41
20	23	24	11	3	23	26	32	3	23	28	26	2	40
21	23	24	14	3	23	26	35	2	23	28	28	2	39
22	23	24	17	2	23	26	37	2	23	28	30	1	38
23	23	24	19	3	23	26	39	2	23	28	31	2	37
24	23	24	22	2	23	26	41	2	23	28	33	1	36
25	23	24	24	3	23	26	43	2	23	28	34	2	35
26	23	24	27	2	23	26	45	2	23	28	36	2	34
27	23	24	29	3	23	26	47	2	23	28	38	1	33
28	23	24	32	2	23	26	49	2	23	28	39	2	32
29	23	24	34	3	23	26	51	2	23	28	41	2	31
30	23	24	37	2	23	26	53	2	23	28	43	1	30
		5				4				3			

	24			dif.	25			dif.	26			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	23	24	37	2	23	26	53	2	23	28	43	1	30
31	23	24	39	3	23	26	55	2	23	28	44	2	29
32	23	24	42	2	23	26	57	2	23	28	46	1	28
33	23	24	44	3	23	26	59	2	23	28	47	2	27
34	23	24	47	2	23	27	1	2	23	28	49	1	26
35	23	24	49	3	23	27	3	2	23	28	50	2	25
36	23	24	52	2	23	27	5	2	23	28	52	1	24
37	23	24	54	3	23	27	7	2	23	28	53	2	23
38	23	24	57	2	23	27	9	2	23	28	55	2	22
39	23	24	59	2	23	27	11	2	23	28	57	1	21
40	23	25	1	3	23	27	13	2	23	28	58	2	20
41	23	25	4	2	23	27	15	2	23	29	0	1	19
42	23	25	6	3	23	27	17	2	23	29	1	2	18
43	23	25	9	2	23	27	19	2	23	29	3	1	17
44	23	25	11	2	23	27	21	2	23	29	4	2	16
45	23	25	13	3	23	27	23	2	23	29	6	1	15
46	23	25	16	2	23	27	25	2	23	29	7	2	14
47	23	25	18	3	23	27	27	2	23	29	9	1	13
48	23	25	21	2	23	27	29	2	23	29	10	1	12
49	23	25	23	2	23	27	31	2	23	29	11	2	11
50	23	25	25	3	23	27	33	2	23	29	13	1	10
51	23	25	28	2	23	27	35	1	23	29	14	2	9
52	23	25	30	2	23	27	36	2	23	29	16	1	8
53	23	25	32	3	23	27	38	2	23	29	17	2	7
54	23	25	35	2	23	27	40	2	23	29	19	1	6
55	23	25	37	2	23	27	42	2	23	29	20	1	5
56	23	25	39	3	23	27	44	2	23	29	21	2	4
57	23	25	42	2	23	27	46	2	23	29	23	1	3
58	23	25	44	2	23	27	48	1	23	29	24	2	2
59	23	25	46	2	23	27	49	2	23	29	26	1	1
60	23	25	48	3	23	27	51	2	23	29	27	1	0
		4				4				3			

	27	dif.	28	dif.	29	dif.	
mi.	*Deg. Mi. Se.*	*Se.*	*Deg. Mi. Se. Th.*	*Th.*	*Deg. Mi. Se. Th.*	*Th.*	*mi.*
0	23 29 27	1	23 30 35 16	53	23 31 16 17	27	60
1	23 29 28	1	23 30 36 9	54	23 31 16 44	27	59
2	23 29 29	2	23 30 37 3	54	23 31 17 11	26	58
3	23 29 31	1	23 30 37 57	54	23 31 17 37	26	57
4	23 29 32	1	23 30 38 51	51	23 31 18 3	25	56
5	23 29 33	1	23 30 39 42	52	23 31 18 28	25	55
6	23 29 34	2	23 30 40 34	52	23 31 18 53	24	54
7	23 29 36	1	23 30 41 26	52	23 31 19 17	24	53
8	23 29 37	1	23 30 42 18	50	23 31 19 41	24	52
9	23 29 38	2	23 30 43 8	50	23 31 20 5	23	51
10	23 29 40	1	23 30 43 58	50	23 31 20 28	22	50
11	23 29 41	1	23 30 44 48	51	23 31 20 50	22	49
12	23 29 42	2	23 30 45 39	49	23 31 21 12	22	48
13	23 29 44	1	23 30 46 28	48	23 31 21 34	21	47
14	23 29 45	1	23 30 47 16	48	23 31 21 55	21	46
15	23 29 46	1	23 30 48 4	48	23 31 22 16	21	45
16	23 29 47	2	23 30 48 52	47	23 31 22 37	19	44
17	23 29 49	1	23 30 49 39	47	23 31 22 56	20	43
18	23 29 50	1	23 30 50 26	46	23 31 23 16	19	42
19	23 29 51	1	23 30 51 12	46	23 31 23 35	18	41
20	23 29 52	1	23 30 51 58	44	23 31 23 53	18	40
21	23 29 53	2	23 30 52 42	45	23 31 24 11	18	39
22	23 29 55	1	23 30 53 27	45	23 31 24 29	17	38
23	23 29 56	1	23 30 54 12	45	23 31 24 46	17	37
24	23 29 57	1	23 30 54 57	42	23 31 25 3	16	36
25	23 29 58	1	23 30 55 39	43	23 31 25 19	16	35
26	23 29 59	2	23 30 56 22	43	23 31 25 35	15	34
27	23 30 1	1	23 30 57 5	43	23 31 25 50	15	33
28	23 30 2	1	23 30 57 48	41	23 31 26 5	14	32
29	23 30 3	1	23 30 58 29	41	23 31 26 19	14	31
30	23 30 4	1	23 30 59 10	41	23 31 26 33	14	30
	2		1		0		

	27			dif.	28				dif.	29				dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Th.	Th.	Deg.	Mi.	Se.	Th.	Th.	mi.
30	23	30	4	1	23	30	59	10	41	23	31	26	33	14	30
31	23	30	5	1	23	30	56	51	41	23	31	26	47	13	29
32	23	30	6	1	23	31	0	32	40	23	31	27	0	12	28
33	23	30	7	2	23	31	1	12	40	23	31	27	12	12	27
34	23	30	9	1	23	31	1	52	38	23	31	27	24	12	26
35	23	30	10	1	23	31	2	30	39	23	31	27	36	11	25
36	23	30	11	1	23	31	3	9	37	23	31	27	47	11	24
37	23	30	12	1	23	31	3	46	38	23	31	27	58	10	23
38	23	30	13	1	23	31	4	24	37	23	31	28	8	10	22
39	23	30	14	1	23	31	5	1	37	23	31	28	18	10	21
40	23	30	15	1	23	31	5	38	35	23	31	28	28	9	20
41	23	30	16	1	23	31	6	13	35	23	31	28	37	8	19
42	23	30	17	1	23	31	6	48	36	23	31	28	45	8	18
43	23	30	18	1	23	31	7	24	37	23	31	28	53	8	17
44	23	30	19	1	23	31	8	1	33	23	31	29	1	7	16
45	23	30	20	1	23	31	8	34	34	23	31	29	8	6	15
46	23	30	21	1	23	31	9	8	34	23	31	29	14	7	14
47	23	30	22	1	23	31	9	42	34	23	31	29	21	5	13
48	23	30	23	1	23	31	10	16	33	23	31	29	26	6	12
49	23	30	24	1	23	31	10	49	32	23	31	29	32	5	11
50	23	30	25	1	23	31	11	21	31	23	31	29	37	4	10
51	23	30	26	1	23	31	11	52	31	23	31	29	41	4	9
52	23	30	27	1	23	31	12	23	31	23	31	29	45	3	8
53	23	30	28	1	23	31	12	54	30	23	31	29	48	3	7
54	23	30	29	1	23	31	13	24	30	23	31	29	51	3	6
55	23	30	30	1	23	31	13	54	30	23	31	29	54	2	5
56	23	30	31	1	23	31	14	24	29	23	31	29	56	2	4
57	23	30	32	1	23	31	14	53	28	23	31	29	58	1	3
58	23	30	33	1	23	31	15	21	28	23	31	29	59	1	2
59	23	30	34	1	23	31	15	49	28	23	31	30	0	0	1
60	23	30	35	1	23	31	16	17	27	23	31	30	0	0	0
		2				1					0				

Chap. XVIII.

The vse of the Table of Declination.

THis Table of Declination is made so particularly to euery minute of the Ecliptick, to auoid tediousnes, in seeking the part proportional, when you would find out thereby either the declination of the Sunne, his place being first giuen in degrees and minutes: or else the place of the Sunne in the Zodiack his declination being first knowne by obseruation, for which cause especially this labour was vndertakē, that hereby it might presently appeare how wel the Ephemerides and Astronomicall Tables hitherto published agree with the truth of the heauens. Wherein many times no small difference is found, euen the Prutenick Tables themselues (which haue been hitherto accounted the most perfect in that kind) disagreeing halfe a degree and more from the truth, and that in the place of the Sunne, whose motion of all others is accounted most simple and regular and most easie to be found out.

To finde out the declination of the Sunne by his place first giuen, by helpe of this Table doe thus: If the Sunne be in *Aries, Taurus, Gemini, Libra, Scorpio,* or *Sagittarie,* seeke the signe and degree of the Sunne in the vpper margine or head of the Table, and the odde minutes (if there be any) in the first columne towards the left hand: Then looke where the line proceeding towards the right hand from the minute of the Sun, crosseth the columne comming downewards from the degree of the Sunne: for there you

haue

haue the declination of the Sunne. But if the Sun be in *Cancer*, *Leo*, *Virgo*, *Capricorne*, *Aquarie*, or *Pisces*, doe contrariwise, that is, seeke the signe and degrees of the Sunne in the nether margine or foote of the table, and the minutes (if there be any) in the last columne next the right hand: and following the line of the minute of the Sunne towards the left hand: and the columne of the degree of the Sunne vpwards, in the common meeting of that line and columne you shall finde the declination of the Sun.

Example of the first: The first of May 1609, the place of the Sunne is in 20 degrees, 45 minutes of *Taurus*, according to the Ephemerides of the Sun hereafter following, made agreeable to many exact obseruations, taken by a quadrant of six foote and a quarter semidiameter in the yeares 1594, 1595, 1596, 1597: Finding therefore *Taurus* and the 20 degree in the vpper part of this table, and 45 minutes in the first columne, I haue in the common meeting (of the columne descending from 20, and of the line proceeding from 45 minutes towards the right hand) 18 degrees, 0 minutes 18 seconds, the declination of the Sunne the same day at noone here at London.

Example of the second: The 15 of August the same yeere by the same Ephemerides, the Sunne is in 2 degr. 2 minutes of *Virgo*. Therefore I seeke *Virgo*, and 2 in the nether part of this table, and $\frac{2}{50}$ minutes in the last columne towards the right hand ascending vpwards. Then following the line of 2 minutes leftwards, and the columne of 2 degrees vpwards in the common meeting of the line and

columne, I finde ten degrees, 47 minutes, 19. sec. the declination of the Sunne the same day at noone for the meridian of London.

But the declination of the Sun being first knowne (by obseruation or otherwise) the place of the Sun shall most easily be found out by this table, after this manner: Seeke the Suns declination in the area of the table: then if the signe wherein the Sunne is (which you may for the most part easily know by estimation) be in the head of the table, ascend vpwards to the top of the same columne in which you found the declination giuen, for there you shal haue the degree of the Sun: follow also the line wherein you finde the giuen declination towards the left hand, till you come to the first columne leftwards, and there you shall haue the minute also.

But if the name of the signe wherein the Sunne is, be in the nether part of the table, you must doe all things contrariwise, descending from the declination found in the area of this table in the same columne, till you come to the lowest part thereof, where you shall finde the degree of the Sunne: and proceeding from the declination towards the right hand in the same line, till you come to the last columne, where you shall finde the minutes to be adioyned, that you may haue the true place of the Sunne.

This way of finding out the place of the Sunne by his declination, first knowne by obseruation, is then of especiall vse and truth, when the Sunne is neere the æquinoctiall points; for there, his declination altereth quickest, increasing or decreasing about

about 24 min. in 24 houres. But when the Sunne is neere either of the Tropicks, the missing of one minute, yea or halfe a minute in obseruing the declination, may cause you erre an whole degree and more in the place of the Sunne. Hee therefore that listeth trie how well the Ephemerides and Astronomicall tables hitherto published agree with the truth of the heauens, had best make obseruation when the Sunne is in *Pisces*, *Aries*, *Virgo*, and *Libra*, where missing one whole minute in obseruing the declination, will cause you misse not past two minutes and an halfe in the true place of the Sun.

When the Sunne is neere either of the æquinoctiall points, there may sometimes bee some small difficultie in finding out what signe the Sunne is in, which may easily be auoided thus: The meridian altitude of the Sunne increasing (as in winter and spring time) if the heigth of the Sunne be lesse then the complement of the poles eleuation, the Sunne is in *Pisces*: otherwise in *Aries*. But if the meridian altitudes of the Sun be euery day lesse then other, (as in summer and Autumne) and the heigth of the Sunne at noone greater then the heigth of the æquinoctiall, the Sunne is in *Virgo*, otherwise in *Libra*.

There may likewise be some doubt in what signe the Sunne is, being neere either of the Tropicks, which may bee resolued thus: the Sunne hauing South declination increasing, is in *Sagittarie*: but if the declination of the Sunne be Southerly and decreasing, hee is in *Capricorne*. Contrariwise the declination of the Sun being Northerly and increasing,

sing, he is in *Gemini*, if decreasing, he is in *Cancer*.

Now whether the declination of the Sunne increase or decrease, you may know by comparing the declinations of two daies together. For if the declination answerable to the second day be greater, the declination increaseth: otherwise it decreaseth. If both daies haue equall declination, the first day the Sunne is in *Gemini*, the second in *Cancer*, if his declination be Northerly; if Southerly, the first day he is in *Sagittarie*, the second in *Capricorne*.

An example or two will make all plaine: The eighth day of April 1597, the declination of the Sunne was found by obseruation to be ten degrees, 55 minutes, 27 seconds, which I seeke out in the area of this table: and in the head of the same columne, in which I finde the declination that commeth neerest vnto this, that is 10 degr. 55 min. 33 sec. I see 28 degrees of *Aries* (for in Aprill the Sunne cannot be in *Libra*) and in the same line wherein I found this declination, in the furtheſt columne towards the left hand I finde 21 minutes, out of which abate 17 seconds, that is, the part proportionall answerable to 6 sec. which is the excesse of 10 degr. 55 minutes, 33 sec. (the declination found in the table) aboue 10 degr. 55 min. 27 sec. (the declination found by obseruation) and there shall remaine the true place of the Sun the same yeere and day 28 degr. 20 min. 43 sec. of *Aries*. Which *Maginus* following *Copernicus* and the Prutenicall tables (as he professeth) maketh to be the 27 degr. 57 minutes of ♈ *Aries* almost: that is, 24 minutes lesse then truth, that æquation also being abated, which is answerable to the difference of longitude

longitude betwixt London and Venice.

The 11 of March the same yeere at London (where by many and diligent obseruations by large and seuerall instruments, the heigth of the pole is found to be 51 degrees, 32 minutes) the apparent meridian altitude of the Sun was exactly obserued to be 38 degrees, 49 minutes: but being corrected by the parallax and refraction of the Sunne, answerable to that height, his true height shall be 38 degr. 51 min. 4 sec. Whereby it appeareth that his true declination the same day at noone was 0 degr. 23 min. 4 sec. and that Northerly, because the heigth of the Sun was greater then the heigth of the æquinoctial. It is plaine therefore that at that time the Sunne was entred into *Aries*. But now to know how farre he was entred; seeke out 0 degr. 23 min. 4 sec. or the number next to it, which is 0 degr. 23. min. 9. sec. in the area of this table: wherwith you shall also finde in the same line in the columne next the left hand 58 minutes, and in the top of the columne right ouer this declination you shall haue 0 degree. Therefore it is manifest that at that time the Sun was in 0 degr. 58 min. of *Aries* almost, for there wanteth onely 12 seconds hereof, that is, the part proportionall answerable to the excesse of 9. sec. aboue 4. sec. Where *Maginus*, after the Prutenick account, maketh it to be in 0 degr. 25 min. of *Aries*; that is, 33 minutes wanting of the truth found by obseruation.

The like difference I haue often found by many and diligent obseruations, especially for the space of the foure yeeres before mentioned: the whole catalogue of which obseruations I thought good (for thy

thy further satisfaction herein) to set downe in a table, (after I haue first shewed with what instrument and after what manner I obserued the same) that if any error herein hath been committed, it may the more easily appeare, and be amended.

Chap. XIX.

The description and vse of a great Quadrant, for obseruation of the Sunne on land.

THe instrument therfore wherewith I tooke those obseruations was a quadrant of more then six foote and a quarter semidiameter, (for the roome wherein I was to vse it, could not well admit a greater quantitie) which by reason of his largenes was so exactly made and diuided, that both minutes and halfe minutes mought therein be easily discerned. The limb and sides of the quadrant were about two inches and a quarter in thicknesse: the breadth of the limbe about foure inches: the breadth of the sides about two inches and an half.

In the midst of the ends of one side of this quadrant were two round holes made, in either end one: whereby the quadrant was hanged (like a gate on his hinges, vpon two round pins, fitted to those holes, and fixed in the ends of a couple of sockets, put close vpon a strong square post, perpendicularly erected, and the vpper end thereof fastned to the side of a principal ratter in an vpper chamber, where a window (according to the reclination of the roof of the house) was made betweene it and the next rafter, in such sort, that carrying your eye along by

the

the circumference of the quadrant, you might by the center therof placed at the window, see any part of the heauens neere the meridian, from the zenith to the horizon. The nether end of this post resting on the floore was put into the midst of a socket nailed to the floore, which was so wide, that on euerie side the post, wedges might be put in to coyne it at pleasure this way or that way, till the side of the quadrant were found to stand exactly perpendicular, by the hanging of the plumbe line all alongst most precisely vpon a line parallel to the zenith line of the quadrant. To the center of the quadrant was fastned a strong ruler of one inch in thicknes, two inches in breadth, and almost six foote and an halfe in length, carrying two sights vpon it (viz at either end one) of equall breadth and length, the end of the middle line of each sight falling perpendicularly vpon the middle or fiduciall line and plaine superficies of the ruler. Through the vpper sight placed at the center was made a square hole as great as it could well be. Through the midst of this sight and hole was put a straight wire, erected perpendicularly from the fiduciall line and plaine of the ruler, and so much of it made flat and thin, as was betweene the top and base of that square hole. This wire serued for obseruing the starres, the flat side whereof was to be turned towards the eye in obseruing of great starres, and the narrow side or edge of it was turned to the eyeward when small stars were to bee obserued. Through the midst of the nether sight (from the toppe of it to the base thereof) was made a narrow slit perpendicularly erected likewise

from

from the fiduciall line and plaine of the ruler and quadrant. When I obserued the starres, I looked through this slit, eleuating and depressing the ruler, till the wire (being first fitted to the bigneſſe of the starre) did euen couer the starre from my sight: in such sort, that I might see both edges of the starre alike on either side aboue and beneath the wire. The square hole in the sight had a couer fitted to it like the couer of a box wherewith it was wholly couered when the Sun was to be obserued. The nether end of the ruler carrying the sights, was to be fastned with a scrue pin, at any part of the circumference of the quadrant as need required.

With this quadrant (alwaies rectified by the plumbe-line in time of obseruation, as before is shewed) the height of the Sun was most easily and exactly obserued, by turning the quadrant this way or that way, and eleuating or depressing the ruler carrying the sights, till the top and sides of the shadow of the vpper sight placed at the center, fell vpon the nether sight placed at the circumference, equidistantly from the top and sides thereof: For then the vpper edge of the ruler shewed precisely the height of the Sunne desired in degrees and minutes vpon the limbe of the quadrant: sauing that one whole degree was alwaies to be added thereto, becauſe the breadth of that part of the ruler that lay vpon the limb of the quadrant was made to be iust equall to two degrees: that is, on either side one degree from the fiduciall line.

Now for finding out the meridian altitudes of the Sunne and starres, I first found the meridian line thus:

thus: With the quadrant rectified and vsed, as before is shewed, I obserued the height of the Sun in the forenoone; and so warily letting the quadrant stand immoueable, and laying the side of a streight ruler (that was about seuen foote in length) close along to the perpendicular side of the quadrant: close by the end of that side of the ruler (touching the floore of the chamber) I made a pricke vpon the floore: Also laying the side of the ruler to the perpendicular side, and limb of the quadrant, I made in like manner another pricke (so farre as conuenientlyI could from the former) vpon the floore, close by the corner of that side of the ruler.

By these two pricks, I drew a right line which represented the intersection of the Sunnes azimuth, or of the continued plaine of the quadrant, and of the plaine of the floore, in the time of obseruation. Likewise in the afternoone (the ruler of the quadrant carrying the sights, being fixed in the same place where it was in time of obseruation, in the forenoone) I obserued diligently till the Sun came to the same height that hee had when I obserued in the forenoone, which I did by following the motion of the Sunnes shadow with the quadrant, till the edges of the top and sides of the shadow of the vpper sight fell vpon the nether sight equidistantly from the top and sides thereof.

Then carefully letting the quadrant stand immoueable, and drawing the line of intersection of the floore, and Sunnes azimuth, in time of the afternoone obseruation, in like manner as I did in the forenoone, setting one foote of the compasses in the intersection

interſection of thoſe two lines, with the other, drawing an arch, ſo great as I could betweene the ſame lines, and finding out the midſt of this arch, a line from the center drawne, by this midſt was the meridian line: ouer which, with helpe of a long ruler laid to the vpright ſide, & limbe of the quadrant, and extended to the floore (as before) I alwaies placed and faſtned the plaine of the quadrant (vnderſtood to be continued to the floore) ſo oft as I obſerued the meridian altitudes of the Sunne or Starres.

Notwithſtanding there is ſome little error in finding the meridian after this manner, except it bee when the Sunne is in, or ſo neere one of the tropicall points, that there can be no ſenſible alteration of his declination between the times of the forenoone and afternoone obſeruations. But the conſequents of this error, in obſeruing meridian altitudes, may for their ſmalneſſe iuſtly bee neglected, and eaſilie auoided, if you attend your obſeruation, but a little before and after the Sunne or Starres to be obſerued, come vpon the meridian thus found. And for the more certaintie, I tooke three obſeruations in the forenoone, and as many in the afternoone, and ſo found out three meridian lines, all parallels each to other without notable difference, which if it ſhould haue chanced to be any, the middlemoſt meridian ſhould be like to be the trueſt.

A TABLE OF OBSERVATIONS OF THE Meridian altitudes of the Sunne, taken *by a large Quadrant of more then six* foote Semidiameter in the yeeres 1594, 1595, 1596, 1597, at *London*, where the eleuation of the Pole was by the same Quadrant and otherwise also, exactly obserued and found to be one and fiftie degrees, and two and thirtie minutes.

1594 *May.*	*The Sunnes*						*The Sunnes apparent declination.*		
	Apparent height.			*True height.*					
Day.	*Deg.*	*Min.*	*Sec.*	*Deg.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
9 Thurſd.	58	14		58	15	36	19	46	0
11 Satur.	58	41		58	42	33	20	13	0
13 Mund.	59	4		59	5	33	20	36	0
14 Tueſd.	59	15		59	16	33	20	47	0
17 Frid.	59	45		59	46	30	21	17	0
26 Sund.	61	1	30	61	2	58	22	33	30
27 Mund.	61	8		61	9	28	22	40	0
28 Tueſd.	61	14		61	15	28	22	46	0
29 Wedneſ.	61	20	30	61	21	58	22	52	30
31 Frid.	61	31		61	32	25	23	3	0
Iune.									
1 Saturd.	61	35		61	36	25	23	7	0
2 Sund.	61	40		61	41	25	23	12	0
4 Tueſd.	61	46	30	61	47	55	23	18	30
6 Thurſ.	61	52	30	61	53	55	23	24	30
7 Frid.	61	54		61	55	25	23	26	0
8 Saturd.	61	55	30	61	56	55	23	27	30
9 Sund.	61	56	30	61	57	55	23	28	30
10 Mond.	61	57		61	58	25	23	29	0
11 Tueſd.	61	58		61	59	25	23	30	0
12 Wedneſ.	61	58		61	59	25	23	30	0
13 Thurſd.	61	57	30	61	58	55	23	29	30
14 Frid.	61	57		61	58	25	23	29	0
15 Saturd.	61	56		61	57	25	23	28	0
22 Saturd.	61	35		61	36	25	23	7	0
23 Sund.	61	32		61	33	25	23	4	0
24 Mund.	61	26	30	61	27	58	22	58	30
Iuly.									
6 Saturd.	59	56	00	59	57	30	21	28	0
8 Mond.	59	36	30	59	38	00	21	8	30

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Deg.	Min.	Sec.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Min	Sec.
19	47	36	28 ♉	2	0	27 ♉	43	0	19	0
20	14	33	♊ 5		30	29	39	0	26	30
20	37	33	1	57	0	1 ♊	34	0	23	0
20	48	33	2	52	40	2	32	0	20	40
21	18	30	5	33	40	5	25	0	8	40
22	34	58	14	10	30	14	2	0	8	30
22	41	28	15	7	0	15	0	0	7	0
22	47	28	16	3	0	15	57	0	6	0
22	53	58	17	7	30	16	55	0	12	30
23	4	25	19	4	30	18	50	0	14	30
23	8	25	19	55	0	19	47	0	8	0
23	13	25	21	5	0	20	44	0	21	0
23	49	55	22	52	0	22	39	0	13	0
23	25	55	25	3	0	24	34	0	29	0
23	27	25	25	46	0	25	31	0	15	0
23	28	25	26	19	0	26	29	0	10	0
23	29	55	27	22	0	27	26	0	4	0
23	30	25	27	50	0	28	23	0	33	0
23	31	25	29	24	0	29	21	0	3	0
23	31	25	0 ♋	35	0	0 ♋	18	0	17	0
23	30	55	1	36	0	1	15	0	21	0
23	30	25	2	10	0	2	12	0	2	0
23	29	25	3	1	30	3	10	0	8	30
23	8	25	10	5	0	9	51	0	46	0
23	5	25	10	43	0	10	48	0	5	0
22	59	58	11	47	30	11	45	0	2	0
21	29	30	23	23	0	23	13	0	10	0
21	10	0	25	13	40	25	8	0	5	40

1594 *Iuly.*	*The Sunnes*						*The Sunnes apparent declination.*		
	Apparent height.			*True height.*					
Day.	*Deg.*	*Min.*	*Sec.*	*Deg.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
9 Tueſd.	59	26	0	59	27	33	20	58	0
15 Mond.	58	14	0	58	15	34	19	46	0
16 Tueſd.	58	1	0	58	2	36	19	33	0
19 Frid.	57	20	0	57	21	39	18	52	0
25 Thurſd.	55	50	0	55	51	41	17	22	0
31 Wedneſ.	54	9	30	54	11	11	15	41	30
Auguſt.									
3 Saturd.	53	15	30	53	17	18	14	47	30
6 Tueſd.	52	19	30	52	21	21	13	51	30
7 Wedneſ.	52	0	0	52	1	51	13	32	0
8 Thurſ.	51	40	30	51	42	21	13	12	30
9 Frid.	51	21	30	51	23	24	12	53	30
12 Mond.	50	23	0	50	24	54	11	55	0
15 Thurſd.	49	21	0	49	22	58	10	53	0
19 Mond.	47	57	0	47	47	59	9	29	0
23 Frid.	46	30	0	46	32	2	8	2	0
24 Satur.	46	7	30	46	9	35	7	39	30
26 Mond.	45	23	30	45	25	32	6	55	30
29 Thurſd.	44	16	0	44	18	4	5	48	0
September.									
16 Mond.	37	18	0	37	19	58	1	10	0
17 Tueſd.	36	54	0	36	55	58	1	34	0
19 Thurſd.	36	7	0	36	8	55	2	21	0
20 Frid.	35	44	0	35	45	55	2	44	0
Octoker.									
1 Tueſday.	31	28	0	31	29	19	7	0	0
3 Thurſd.	30	43	30	30	44	49	7	44	30
4 Friday.	30	21	0	30	22	11	8	7	0
5 Saturd.	29	58	30	29	59	41	8	29	30
16 Wedneſ.	26	0	30	26	0	58	12	27	30

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Deg.	Min.	Sec.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Min	Sec
20	59	33	26	10	0	26	5	0	5	0
19	47	34	1 ♌	58	0	1 ♌	50	0	8	0
19	34	36	2	55	0	2	47	0	11	0
18	53	39	5	47	45	5	39	0	8	45
17	23	41	11	29	52	11	25	0	4	52
15	43	11	17	15	6	17	10	0	5	6
14	49	18	20	8	30	20	3	0	5	30
13	53	21	23	2	0	22	57	0	5	0
13	33	51	24	1	0	23	54	0	7	0
13	14	21	24	59	0	24	52	0	7	0
12	55	24	25	55	20	25	50	0	5	20
11	56	54	28	45	24	28	44	0	1	24
10	54	58	1 ♍	40	36	1 ♍	38	0	2	36
9	19	59	6	1	40	5	30	0	31	40
8	4	2	9	25	0	9	22	0	3	0
7	41	35	10	24	15	10	21	0	3	15
6	57	32	12	19	45	12	17	0	2	45
5	50	4	15	14	45	15	12	0	2	45
1	8	2	2 ♎	50	30	2 ♎	48	0	2	0
1	32	2	3	50	42	3	47	0	2	42
2	19	5	5	49	0	5	45	0	2	0
2	42	5	6	46	52	6	44	0	2	52
6	58	41	17	43	13	17	35	0	6	13
7	43	11	19	40	0	19	34	0	6	0
8	5	49	20	39	48	20	33	0	6	48
8	28	19	21	39	36	21	33	0	6	36
12	27	2	2 ♏	40	36	2 ♏	30	0	10	0

1594 October.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
18 Friday.	25	20	30	25	20	44	13	7	30
19 Saturd.	25	0	0	25	0	14	13	28	0
21 Mond.	24	20	0	24	19	45	14	8	0
25 Friday.	23	5	0	23	4	16	15	23	0
29 Tueſd.	21	52	0	21	50	48	16	36	0
Nouember.									
1 Friday.	21	0	0	20	58	19	17	28	0
3 Sund.	20	27	0	20	24	50	18	1	0
4 Mond.	20	12	0	20	9	50	18	16	0
7 Thurſd.	19	27	0	19	24	20	19	1	0
10 Sund.	18	43	0	18	40	20	19	45	0
19 Tueſd.	16	55	0	16	51	22	21	33	0
20 Wedneſ	16	45	0	16	41	22	21	43	0
22 Friday.	16	27	0	16	22	53	22	1	0
23 Saturd.	16	18	0	16	13	53	22	10	0
27 Wedneſ.	15	48	0	15	43	53	22	40	0
28 Thurſd.	15	41	0	15	36	53	22	47	0
29 Friday.	15	35	0	15	30	53	22	53	0
December.									
17 Tueſd.	15	6	0	15	1	24	23	22	0
18 Wedneſ.	15	9	0	15	4	24	23	19	0
20 Friday.	15	16	0	15	11	24	23	12	0
22 Sunday.	15	25	0	15	20	24	23	3	0
29 Sunday.	16	10	30	16	6	23	22	17	30
Ianuary.									
9 Thurſd.	18	4	30	18	1	21	20	23	30
18 Saturd.	30	13	0	20	10	50	18	15	0
23 Thurſd.	21	35	0	21	33	48	16	53	0
26 Sunday.	22	28	30	22	27	18	15	59	30
31 Friday.	24	3	0	24	2	45	14	25	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Mi.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
13	7	16	4	42	42	4	30	0	12	42
13	27	46	5	40	51	5	30	0	10	51
14	8	15	7	43	45	7	30	0	13	45
15	23	44	11	41	30	11	30	0	11	30
16	37	12	15	46	20	15	31	0	14	20
17	29	41	18	51	48	18	32	0	19	48
18	3	10	20	55	48	20	33	0	22	48
18	18	10	21	53	4	21	33	0	20	4
19	3	40	24	54	12	24	35	0	19	12
19	47	40	28	2	25	27	36	0	26	25
21	36	38	7	♓ 19	30	6	♓ 43	0	36	30
21	46	38	8	21	12	7	43	0	38	12
22	5	7	10	23	6	9	45	0	38	6
22	14	7	11	27	0	10	46	0	41	0
22	44	7	15	31	20	14	49	0	42	20
22	51	7	16	38	30	15	50	0	48	30
22	57	7	17	40	50	16	48	0	52	50
23	26	36	4	♑ 38	30	5	♑ 10	0	31	30
23	23	36	5	53	30	6	11	0	18	30
23	16	36	8	5	45	8	13	0	7	15
23	7	36	10	15	36	10	16	0	0	24
22	21	37	17	37	0	17	23	0	14	0
20	26	39	28	56	40	28	35	0	21	4
18	17	10	8	♒ 10	45	7	♒ 43	0	27	45
16	54	12	13	14	38	12	47	0	27	38
16	0	42	16	17	10	15	50	0	27	10
14	25	15	21	23	48	20	53	0	30	48

1595 February.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
1 Saturd.	24	22	0	24	21	45	14	6	0
5 Wedneſ.	25	43	0	25	43	28	12	45	0
8 Satur.	26	46	0	26	46	41	11	42	0
13 Thurſd.	28	33	0	28	34	2	9	55	0
15 Saturd.	29	19	0	29	20	2	9	9	0
16 Sund.	29	40	30	29	41	41	8	47	30
17 Mond.	30	3	0	30	4	11	8	25	0
20 Thurſd.	31	11	30	31	12	49	7	16	30
21 Frid.	31	34	0	31	35	27	6	54	0
27 Thurſd.	33	54	0	33	55	44	4	34	0
March.									
1 Saturd.	34	40	0	34	41	52	3	48	0
3 Mond.	35	27	0	35	28	52	3	1	0
12 Wedneſ.	39	0	0	39	2	4	0	32	0
15 Saturd.	40	10	0	40	12	8	1	42	0
17 Mond.	40	58	0	41	0	7	2	30	0
18 Tueſd.	41	22	0	41	24	7	2	54	0
19 Wedneſ.	41	45	0	41	47	6	3	17	0
20 Thurſ.	42	9	0	42	11	6	3	41	0
21 Frid.	42	31	0	42	33	5	4	3	0
25 Tueſd.	44	4	0	44	6	4	5	36	0
26 Wedneſ.	44	26	30	44	28	34	5	58	30
27 Thurſd.	44	49	0	44	51	2	6	21	0
31 Mond.	46	19	0	46	21	5	7	51	0
Aprill.									
3 Thurſd.	47	25	0	47	27	3	8	57	0
7 Mond.	48	51	0	48	52	58	10	23	0
8 Tueſday.	49	12	0	49	13	58	10	44	0
14 Mond.	51	14	0	51	15	54	12	46	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
14	6	15	22	22	24	21	53	0	29	24
12	44	32	26	27	18	25	56	0	31	18
11	41	19	29	29	54	28	57	0	32	54
9	53	58	4 ♓	29	14	3 ♓	59	0	30	14
9	7	58	6	34	6	5	59	0	35	6
8	46	19	7	32	18	6	59	0	33	18
8	23	49	8	32	23	7	59	0	33	23
7	15	11	11	33	36	11	0	0	33	36
6	52	33	12	32	45	12	0	0	32	45
4	32	16	18	34	3	17	59	0	35	3
3	46	8	20	31	17	19	59	0	32	17
2	59	8	22	30	8	21	58	0	32	8
0	34	4	1 ♈	25	22	0 ♈	55	0	30	22
1	44	8	4	21	5	3	53	0	28	5
2	32	7	6	21	45	5	51	0	30	45
2	56	7	7	22	15	6	50	0	32	15
3	19	6	8	20	18	7	50	0	30	18
3	43	6	9	21	3	8	49	0	32	3
4	5	5	10	16	48	9	48	0	28	48
5	38	4	14	14	23	13	44	0	30	23
6	0	34	15	12	20	14	43	0	29	20
6	23	2	16	10	30	15	42	0	28	30
7	53	5	20	6	5	19	38	0	28	5
8	59	3	23	1	52	22	34	0	27	52
10	24	58	26	56	0	26	28	0	28	0
10	45	58	27	54	16	27	27	0	27	16
12	47	54	3 ♉	42	33	3 ♉	18	0	24	33

1595 *May.*	*The Sunnes*						*The Sunnes apparent declination.*		
	Apparent height.			*True height.*					
Day.	*Deg.*	*Min.*	*Sec.*	*Deg.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
3 Saturd.	56	47	0	56	48	39	18	19	0
6 Tueſd.	57	29	30	57	31	9	19	1	30
14 Wedneſ.	59	10	0	59	11	33	20	42	0
17 Saturd.	59	43	30	59	45	0	21	25	30
21 Wedneſ.	60	21	30	60	23	0	21	53	30
23 Friday.	60	38	0	60	39	28	22	10	0
24 Saturd.	60	46	0	60	47	28	22	18	0
29 Thurſd.	61	19	0	61	20	28	22	51	0
Iune.									
7 Saturd.	61	54	0	61	55	25	23	26	0
9 Mond.	61	56	30	61	57	55	23	28	30
21 Saturd.	61	40	30	61	41	55	23	12	30
23 Mond.	61	32	0	61	33	25	23	4	0
26 Thurſd.	61	16	0	61	17	28	22	48	0
Iuly.									
30 Wedneſ.	54	30	0	54	31	45	16	2	0
31 Thurſ.	54	14	0	54	15	46	15	46	0
Auguſt.									
1 Frid.	53	56	0	53	57	46	15	28	0
2 Saturd.	53	37	0	53	38	46	15	9	0
8 Frid.	51	45	0	51	46	51	13	17	0
9 Satur.	51	26	0	51	27	54	12	58	0
10 Sund.	51	6	0	51	7	54	12	38	0
19 Tueſd.	48	2	0	48	4	0	9	34	0
21 Thurſd.	47	20	0	47	22	3	8	52	0
23 Friday.	46	57	30	46	59	33	8	29	30
26 Tueſd.	45	30	0	45	32	4	7	2	0
29 Friday.	44	22	0	44	24	4	5	54	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
18	20	39	22	2	40	21	42	0	20	40
19	3	9	24	52	4	24	36	0	16	4
20	43	33	2 ♊	27	10	2 ♊	17	0	10	10
21	17	0	5	25	12	5	10	0	15	12
21	55	0	9	15	0	9	1	0	14	0
22	11	28	11	7	45	10	56	0	11	45
22	19	28	12	6	38	11	53	0	13	38
22	52	28	16	52	10	16	40	0	12	10
23	27	25	25	46	0	25	17	0	29	0
23	29	55	27	22	0	27	12	0	10	0
23	13	55	8 ♋	47	45	8 ♋	39	0	8	45
23	5	25	10	43	15	10	34	0	9	15
22	49	28	13	37	50	13	26	0	11	50
16	3	45	16 ♌	7	0	15 ♌	58	0	9	0
15	47	46	17	0	3	16	56	0	4	3
15	29	46	17	58	57	17	54	0	4	57
15	10	46	19	0	16	18	51	0	9	16
13	18	51	24	45	48	24	38	0	7	48
12	59	54	25	42	6	25	36	0	6	6
12	39	54	26	40	54	26	34	0	6	54
9	36	0	5 ♍	18	14	5 ♍	15	0	3	14
8	54	3	7	11	32	7	12	0	0	28
8	31	33	8	11	46	8	10	0	1	46
7	4	4	12	2	44	12	3	0	0	16
5	56	4	14	59	16	14	58	0	1	16

1595 *September.*	*The Sunnes* *Apparent height.*			*True height.*			*The Sunnes apparent declination.*		
Day.	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
7 Sund.	40	54	0	40	56	7	2	26	0
8 Mond.	40	30	0	40	32	7	2	2	0
9 Tueſd.	40	7	0	40	9	8	1	39	0
10 Wed.	39	44	0	39	46	8	1	16	0
11 Thurſd.	39	20	0	39	22	5	0	52	0
16 Tueſd.	37	23	30	37	25	29	1	4	30
17 Wed.	37	0	0	37	1	58	1	28	0
18 Thurſd.	36	36	0	36	37	58	1	52	0
19 Friday.	36	12	0	36	13	55	2	16	0
20 Saturd.	35	48	30	35	50	25	2	39	30
23 Tueſd.	34	38	0	34	39	52	3	50	0
26 Friday.	33	29	0	33	30	39	4	59	0
October.									
2 Thurſd.	31	11	30	31	12	49	7	16	30
3 Friday.	30	48	0	30	49	19	7	40	0
9 Thurſd.	28	35	0	28	35	59	9	53	0
11 Saturd.	27	52	0	27	52	54	10	36	0
12 Sund.	27	30	0	27	30	47	10	58	0
15 Wedneſ	26	26	30	26	27	3	12	1	30
17 Friday.	25	45	0	25	45	25	12	43	0
30 Thurſd.	21	37	30	21	36	8	16	50	30
Nouemb.									
18 Tueſd.	17	8	0	17	4	26	21	29	0
19 Wed.	16	58	0	16	54	21	21	30	0
20 Thurſd.	16	48	0	16	44	16	21	40	0
24 Mond.	16	13	30	16	9	30	22	14	30

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
2	28	7	23	48	18	23	44	0	4	18
2	4	7	24	48	42	24	43	0	5	42
1	41	8	25	46	25	25	41	0	5	25
1	18	8	26	44	10	26	40	0	4	10
0	54	5	27	44	27	27	39	0	5	27
1	2	31	2 ♑	36	40	2 ♑	33	0	3	40
1	26	2	3	35	40	3	32	0	3	40
1	50	2	4	35	55	4	31	0	4	55
2	14	5	5	36	22	5	30	0	6	22
2	37	35	6	35	32	6	29	0	6	32
3	48	8	9	33	52	9	26	0	7	52
4	57	21	12	29	57	12	24	0	5	57
7	15	11	18	26	22	18	20	0	6	22
7	38	41	19	28	5	19	19	0	9	5
9	52	1	25	25	27	25	17	0	8	27
10	35	6	27	24	3	27	16	0	8	3
10	57	13	28	25	40	28	16	0	9	40
12	0	57	1 ♍	26	14	1 ♍	15	0	11	14
12	42	35	3	26	57	3	15	0	11	57
16	51	52	16	37	14	16	16	0	21	14
21	23	34	6 ♎	2	30	5 ♎	27	0	35	30
21	33	39	7	1	33	6	28	0	33	33
21	43	44	8	3	0	7	28	0	35	0
22	18	30	11	59	22	11	32	0	27	22

1595 December.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
2 Tueſd.	15	20	30	15	15	34	23	7	30
10 Wedneſ.	15	0	0	14	55	30	23	28	0
12 Friday.	14	58	0	14	53	23	23	30	0
18 Thurſd.	15	8	0	15	3	28	23	20	0
20 Saturd.	15	14	0	15	9	31	23	14	0
21 Sund.	15	18	0	15	13	33	23	10	0
24 Wed.	1	34	0	15	29	40	22	54	0
30 Tueſd.	16	16	0	16	12	0	22	12	0
1596. *Ianuary.*									
1 Thurſd.	16	34	0	16	30	7	21	54	0
3 Saturd.	16	53	0	16	44	18	21	35	0
10 Saturd.	18	14	0	28	18	58	20	14	0
12 Mond.	18	39	30	18	36	40	19	48	30
14 Wedneſ.	19	8	0	19	5	24	19	20	0
22 Thurſd.	21	14	0	21	12	26	17	14	0
24 Wedneſ.	21	48	0	21	16	42	16	40	0
February.									
13 Friday.	28	29	0	28	29	58	9	59	0
17 Tueſd.	29	57	0	29	58	10	8	31	0
18 Wed.	30	10	0	30	11	12	8	18	0
24 Tueſd.	32	37	30	32	39	2	5	50	30
25 Wed.	33	1	0	33	2	35	5	27	0
26 Thurſd.	33	24	0	33	25	39	5	4	0
29 Sund.	34	34	30	34	36	19	3	53	30
March.									
13 Saturd.	39	42	0	39	44	7	1	14	0
14 Sund.	40	6	0	40	8	8	1	38	0
16 Tueſd.	40	52	0	4	54	7	2	24	0

The Sunnes true declination.			*The Suns place by obſervation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec.*
23	12	26	20	50	15	19	39	0		
23	32	30				27	47	0		
23	34	37				29	50	0		
23	24	32	5	32	0	5 ♑	56	0	24	0
23	18	29	7	34	0	7	58	0	24	0
23	14	27	8	39	45	8	59	0	19	15
22	58	20	12	5	50	12	3	0	2	50
22	16	0	18	19	15	18	9	0	10	15
21	57	53	20	26	0	20	11	0	15	0
21	38	42	22	28	0	22	14	0	14	0
20	17	2	29	42	45	29	22	0	20	45
19	51	20	1 ♒	41	13	1 ♒	23	0	18	13
19	22	36	3	46	34	3	25	0	21	34
17	15	34	11	59	4	11	32	0	27	4
16	41	18	13	59	30	13	30	0	29	30
9	58	2	4 ♓	18	6	3 ♓	40	0	38	6
8	29	50	8	16	22	7	44	30	31	52
8	16	48	8	51	3	8	45	0	6	3
5	48	57	15	18	10	14	45	0	33	10
5	25	25	16	18	8	15	45	0	33	8
5	2	21	17	17	15	16	45	0	32	15
3	51	41	20	17	12	19	45	0	32	12
1	16	7	3 ♈	10	48	2 ♈	39	0	31	48
1	40	8	4	11	2	3	38	0	33	2
2	26	7	6	6	40	5	37	0	29	40

1596 Aprill.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
20 Tueſd.	53	23	0	53	24	48	14	55	0
24 Saturd.	54	35	0	54	36	44	16	7	0
25 Sund.	54	51	30	54	53	13	16	23	30
26 Mond.	55	8	30	55	10	13	16	40	30
28 Wed.	55	41	0	55	42	41	17	13	0
29 Thurſd.	55	57	0	55	58	36	17	29	0
May.									
4 Tueſd.	57	13	0	57	14	39	18	45	0
11 Tueſd.	58	45	30	58	47	5	20	17	30
Iune.									
15 Tueſd.	61	54	0	61	55	25	23	26	0
18 Friday.	61	47	0	61	48	25	23	19	0
Iuly.									
24 Saturd.	55	56	0	55	57	41	17	28	30
27 Tueſd.	55	8	0	55	9	43	16	40	0
29 Thurſd.	54	34	0	54	35	44	16	6	0
30 Friday.	54	17	0	54	18	46	15	49	0
31 Saturd.	54	0	0	54	1	46	15	32	0
Auguſt.									
10 Tueſd.	50	51	0	50	52	54	12	23	0
13 Friday.	49	50	30	49	52	26	11	22	30
16 Mond.	48	48	0	48	49	58	10	20	0
21 Saturd.	47	1	30	47	3	33	8	33	30
30 Mond.	43	41	0	43	43	4	5	13	0
31 Tueſd.	43	17	30	43	19	35	4	49	30
September.									
5 Sund.	41	22	30	41	24	37	2	54	30
6 Mond.	40	59	0	41	1	7	2	31	0
7 Tueſd.	40	36	0	40	38	7	2	8	0
8 Wed.	40	12	30	40	14	38	1	44	30

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Deg.	Min.	Sec.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Min	Sec
14	56	48	10 ♉	15	13	9 ♉	51	0	24	13
16	8	44	14	9	40	13	44	0	25	40
16	25	13	15	5	20	14	42	0	23	20
16	42	13	16	3	42	15	40	0	23	42
17	14	41	17	57	45	17	36	0	21	45
17	30	36	18	55	10	18	34	0	21	10
18	46	39	23	45	4	23	24	0	21	4
20	19	5	0 ♊	27	0	0 ♊	8	0	19	0
23	27	25	4 ♋	14	0	3 ♋	39	0	35	0
23	20	25	6	58	40	6	31	0	27	40
17	29	41	11 ♌	8	11	10 ♌	56	0	12	11
16	41	43	13	58	3	13	49	0	9	3
16	7	44	15	53	40	15	44	0	9	40
15	50	46	16	50	10	16	42	0	8	10
15	33	46	17	45	3	17	39	0	6	3
12	24	54	27	24	24	27	17	0	7	24
11	24	26	0 ♍	17	48	0 ♍	11	0	6	48
10	21	58	3	12	17	3	5	0	7	17
8	35	33	8	1	5	7	55	0	6	5
5	15	4	16	44	40	16	40	0	4	40
4	51	35	17	44	47	17	38	30	6	17
2	56	37	22	36	26	22	31	0	5	26
2	33	7	23	35	43	23	30	0	5	43
2	10	7	24	33	40	24	28	0	5	40
1	46	38	25	32	38	25	27	0	5	38

1596 September.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
13 Mond.	38	16	0	38	18	1	0	12	0
14 Tueſd.	37	52	0	37	54	1	0	36	0
25 Saturd.	33	34	30	33	36	10	4	53	30
27 Mond.	32	48	0	32	49	34	5	40	0
October.									
4 Mond.	30	9	0	30	10	12	8	19	0
Novemb.									
2 Tueſd.	20	35	0	20	33	7	17	53	0
5 Frid.	19	47	30	19	45	14	18	40	30
1597 *Ianuary.*									
25 Tueſday.	22	19	0	22	17	57	16	9	0
29 Saturd.	23	34	0	23	33	32	14	54	0
March.									
11 Frid.	38	49	0	38	51	4	0	21	0
12 Saturd.	39	13	0	39	15	4	0	45	0
13 Sund.	39	36	30	39	38	36	1	8	30
14 Mond.	40	0	0	40	2	8	1	32	0
15 Tueſd.	40	23	0	40	25	8	1	55	0
16 Wedneſ.	40	46	30	40	48	37	2	18	30
20 Sund.	42	21	30	42	23	36	3	53	30
21 Mond.	42	44	0	42	46	5	4	16	0
Aprill.									
8 Friday.	49	21	30	49	23	27	10	53	30
30 Satur.	56	9	0	56	10	41	17	41	0
May.									
2 Mond.	56	40	0	56	41	40	18	12	0
Iune.									
9 Thurſd.	61	57	0	61	58	25	23	29	0
11 Saturd.	61	58	0	61	59	25	23	30	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
0	9	59	0 ♎	25	0	0 ♎	21	0	4	0
0	33	59	1	25	10	1	19	30	5	40
4	51	50	12	15	52	12	9	0	6	52
5	38	26	14	15	18	14	8	0	7	18
8	17	48	21	11	35	21	3	0	8	35
17	54	53	20 ♏	24	41	20 ♏	3	0	21	41
18	42	46	23	29	30	23	4	0	25	30
16	10	3	15 ♐	45	53	17 ♐	20	0	25	53
14	54	28	19	52	9	19	22	0	30	9
0	23	4	0 ♑	57	48	0 ♑	25	0	32	48
0	47	4	1	57	55	1	25	0	32	55
1	10	36	2	56	58	2	24	0	32	58
1	34	8	3	56	0	3	23	0	33	0
1	57	8	4	53	45	4	23	0	30	45
2	20	37	5	52	50	5	22	0	30	50
3	55	36	9	52	45	9	19	0	33	45
4	18	5	10	49	50	10	18	0	31	50
10	55	27	28	20	43	27	57	0	23	43
17	42	41	19 ♉	39	22	19 ♉	18	0	21	22
18	13	40	21	35	48	21	14	0	21	48
23	30	25	27 ♊	50	0	27 ♊	41	0	9	0
23	31	25	29	24	0	29	35	0	11	0

1597 *Iune.*	*The Sunnes*						*The Sunnes apparent declination.*		
	Apparent height.			*True height.*					
Day.	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*
12 Sund.	61	58	0	61	59	25	23	30	0
13 Mond.	61	57	30	61	58	55	23	29	30
19 Sund.	61	46	0	61	47	25	23	18	0
Iuly.									
4 Mond.	60	12	30	60	14	0	21	44	30
5 Tueſd.	60	3	30	60	5	0	21	35	30
6 Wed.	59	54	0	59	55	30	21	26	0
8 Friday.	59	34	0	59	35	31	21	6	0
24 Sund.	56	1	30	56	3	11	17	33	30
26 Tueſd.	55	30	0	55	31	42	17	2	0
Auguſt.									
3 Wed.	53	11	0	53	12	48	14	43	0
9 Tueſd.	51	16	0	51	17	53	12	48	0
Septemb.									
22 Thurſd.	34	50	0	34	51	51	3	38	0
30 Friday.	31	44	30	31	45	55	6	43	30
October.									
6 Thurſd.	29	29	0	29	30	6	8	59	0
12 Wed.	27	19	0	27	19	45	11	9	0
14 Friday.	26	36	30	26	37	5	11	51	30
24 Mond.	23	16	0	23	15	23	15	12	0
27 Thurſd.	22	22	0	22	20	50	16	6	30
29 Saturd.	21	46	0	21	44	41	16	42	0
Nouemb.									
3 Thurſd.	20	24	0	20	22	2	18	4	0
7 Mond.	19	21	30	19	19	0	19	6	30
22 Tueſd.	16	24	0	16	20	5	22	4	0

The Sunnes true declination.			The Suns place by observation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Mi.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
23	31	25	0♋	36	0	0♋	33	0	3	0
23	30	55	1	35	0	1	30	0	5	0
23	19	25	7	17	20	7	14	0	3	20
21	46	0	21	43	0	21	33	0	10	0
21	37	0	22	38	18	22	31	0	7	18
21	27	30	23	34	42	23	28	8	6	42
21	7	31	25	27	11	25	23	0	4	11
17	35	11	10♌	48	8	10♌	42	0	6	8
17	3	42	12	41	14	12	37	0	4	14
14	44	48	20	22	41	20	18	0	4	41
12	49	53	26	11	36	26	5	0	6	36
3	36	9	9♎	3	26	8♎	57	0	6	26
6	42	5	16	59	57	16	51	0	8	57
8	57	54	22	58	13	22	48	0	10	13
11	8	15	28	56	34	28	46	0	10	34
11	50	55	0♏	57	28	0♏	45	0	12	28
15	12	37	11	5	41	10	46	0	19	41
16	7	10	14	4	23	13	46	0	18	23
16	43	19	16	7	30	15	47	0	20	30
8	5	58	21	6	26	20	48	0	18	26
16	9	0	25	16	16	24	50	0	26	16
22	7	55	10♑	42	36	10	1	0	41	36

Chap. XX.

The finding of the Sunnes Apogæum and eccentricitie out of the former obseruations.

NOw by the whole course of these obseruations, it manifestly appeareth, that the declinations set down in the regiments of the Sunne, that are, and haue bin hitherto ordinarily vsed by our sea men, do for the most part notably erre from the truth of the heauens. Which errors as they may most truly be corrected by obseruatiõ only in those daies wherein certaine obseruation was made: so for finding out the declinations of the middle daies betweene the obseruations, I thought it the best way, first to make the Ephemerides of the Sunne hereafter following, agreeable to the former obseruations, and then to finde out the declinations answerable to the places of the Sunne for euery day of foure yeeres together, becausе that after that number of yeeres the same places of the Sunne, and the same declinations returne againe without sensible error, which also by a certaine æquation may be corrected: and for the easier finding out of this æquation, I haue continued these Tables for one yeere more, making them for fiue yeeres, and so including two leape yeeres, by the difference of which yeeres we may easily find the said æquation, by meanes whereof these Tables may be made seruiceable for many yeeres.

First therefore for making these Ephemerides, it is needfull to know the time of the Sunnes entrance into

into certaine principall points of the Zodiack: as also the time of the Sunnes continuance in the arches of the Zodiack conteined betweene those points, whereby the proportion of the Sunnes motion may geometrically bee found out, his eccentricitie and place of his apogæum being hereby knowne.

To know the time of the Suns comming to any point of the ecliptick, it is best to obserue exactly the meridian altitude of the Sunne, not only the same day wherein hee is like to enter into the point desired, but euery day also, for two or three daies together both before and after that day, that both by the testimonie of so many obseruations compared together, you may haue the more assured truth: as also, that if the day you most desire fall not out to be so cleere as you would wish, you may notwithstanding, by the obseruations of the daies going before, and following after, or either of them, obtaine your desire.

To know the time of the Sunnes comming to any point of the Ecliptick.

Hauing thus obserued the meridian altitudes of the Sunne, and thereby also found his declinations for euery one of those daies wherein you obserued, you shall easily know also the true place of the Sun in euery each one of the same daies, with helpe of the former table of the declination of euery minute of the ecliptick, in such sort as before was declared, when I shewed the vse of that Table.

Now if it fall out so happily, that both the day be cleere, when the Sun entreth into the desired point of the ecliptick, and that the place of the Sunne answerable to the declination of that day, be all one with the point desired, you haue alreadie that you

sought for, without any more adoe, *viz.* that the Sunne entreth that day at noone into the point desired. Otherwise subtract the obserued place of the Sunne, next before the point desired out of the obserued place of the Sun, next following that point, and the remainder shall shew you the true motion of the Sunne, answerable to the time between those obseruations. Subtract also the former place of the Sunne, from his place in the point desired, and note the difference: for as the former remainder (that is the apparent motion of the Sunne between the obseruations) is to the time betweene those obseruations: so is this difference to the time betweene the first obseruation, and the Sunnes entrance into the point desired.

Example of the first: I desired to know the time of the Sunnes entrance into 17 degrees, 0 min. of ♌ in the yeere 1595. I obserued therefore (at London) the apparent height of the Sunne at noone, the 31 of Iuly the same yeere, and found it to be 54 degrees, 14 minutes, out of which his true height (corrected by his parallax) was found to be 54 degr. 15 min. 46. sec. whereby his declination was gathered to be 15. degrees, 47 minutes, 46 sec. and consequently his place in 17 degrees, 0 minutes of ♌ that day at noone.

Example of the second: admit the yeere following 1596 you would know the time of the Sunnes entrance into the midst of *Taurus*. Hauing therfore to this end obserued the apparent meridian altitudes of the Sunne, the 24, 25, and 26 daies of April, in that yeere (within the space of which daies I am sure

sure the Sunne must needs be in that point) to bee 54 degrees, 35 minutes, 54 degrees, 51 min. $\frac{1}{2}$, 55 degrees, 8 min. $\frac{1}{2}$, and consequently the true heights 54 degr. 36 min. 44 sec. 54 degr. 53 min. 13 sec. 55 degrees, 10 min. 13 sec. and out of these the true declinations 16 degr. 8 min. 44 sec. 16 degr. 25 min. 13 sec. 16. degr. 52. min. 13. sec. Hereby I found the true places of the Sun the same daies to be 14 deg. 9 min. 40 sec. of *Taurus*, 15 degr. 5 min. 20 sec. of *Taurus*, 16 deg. 3 min. 42 sec. of *Taurus*. Subtracting therfore 14 degr. 9 min. 40 sec. of *Taurus*, (that is, the place of the Sunne the 24 day) out of 15 degr. 5 min. 20 sec. of *Taurus*, the place of the Sun the 25 day) the remainder shall be 55 min. 40 sec. which is the true motion of the Sunne, betweene the 24, and 25 daies at noone, that is, the diurne motion of the Sunne at that time. Subtracting also 14 degr. 9 min. 40 sec. of *Taurus*, out of 15 degr. 0 min. of *Taurus*, the differēce is 50 min. 20 sec. Now as 55 min. 40 sec. is to 50 minutes, 20 sec. so are 24 houres, to 21 houres, 42 min. and 2 sec. It appeareth therefore by subtracting 21 houres, 42 min. 2 sec. out of 24 houres, that the Sun should enter into the midst of *Taurus*, the 25 day, about two houres and almost 18 min. before noone, that is, at nine a clock, and 42 minutes.

Now supposing I had not, or could not haue observed the 25 day, I may notwithstanding finde the time of the Sunnes entrance into the midst of *Taurus*, by the obseruations of the 24 and 26 daies after this maner: Subtract 14 degr. 9 min. 40 sec. of *Taurus*, out of 16 degr. 3 min. 42 sec. of *Taurus*, the remainder will be one degr. 54 min. 2 sec. that is the

motion

motion of the Sunne for two daies, betweene the 24 and 26 daies at noone. Therefore as 1 degr. 54 min. is to 48 houres: so are 50 min. 20 sec. (that is the difference of the place of the Sunne the 24 day from the midst of *Taurus*, found out as before) to 21 houres and 12 min. almost. So as hereby it seemeth the Sunne should enter into the midst of *Taurus* the 25 day about two houres and 48 minutes before noone, that is, at nine of the clock and 12 minutes.

But if it so fall out that you do not or cannot obserue, both before and after the time of the Sunnes comming to the point desired, (as suppose I could not haue obserued the 24 day, but only the 25 and 26 daies, in both which daies the Sunne is gone past the point desired) notwithstanding you may obtaine your desire thus: Subtract 15 degr. 5 min. 20 sec. *Taurus*, (the place of the Sunne the 25 day) out of 16 degr. 3 min. 42 sec. *Taurus* (the place of the Sun the 26 day) there will remaine 58 min. 22 sec. the diurne motion of the Sunne betweene the noone-tides of the 25 and 26 daies. Now because that on the 25 day at noone the Sunne was gone 5 min. 20 sec. past the point desired: therefore as 58 min. 20 sec. are to 24 houres, so are 5 min. 20 sec. to 2 houres 12 min. almost. By this account then the Sun should enter into the midst of *Taurus* the 25 day, 2 houres and about 12 min. before noone: that is, at nine of the clock and 48 minutes. Neither ought that small difference that appeareth betweene these accounts to be greatly regarded, which amounts not to so much as halfe an houre, in which time the motion

of

of the Sunne is little aboue a minute, and the declination of the Sunne in that part of the Zodiack cannot alter so much as $\frac{1}{3}$ of a minute, which is so small, as can by sense very hardly be obserued or discerned. Neither yet ought that little difference of a minute or two that appeareth betweene the diurne motions of the Sunne, found by obseruation, greatly moue any man (in that by the first and second obseruations the diurne motion should be almost 56 min. by the first and third 57 min. by the second and third 58 min. and more) the greatest of which differences may almost arise by erring but one halfe minute only, in taking the height of the Sun; which error is in a manner altogether insensible, and will be easily pardoned by them that haue or shall accustome themselues to make the like obseruations, when besides their owne experience they shall find that they which haue most excelled in this Art, as *Tycho Brahe de recentiorib. ætherei mundi phænom. lib. 2 cap. 10. part 1. Copern. Reuol. libr. 4. cap. 21.* and *Ptolemee* himselfe in all his Catalogue of the fixed starres, *Almagest lib. 7. cap. 5.* when they shall finde (I say) that euen these Princes in Astronomie, so greatlie exercised in obseruations, haue accounted an whole minute or two, hardly sensible: *Ptolemee* also in his *Almagest* contenting himselfe, for the most part, to haue set down the places of the fixed starres to sixth parts of degrees, and very seldome comming to twelfth parts, thinking it sufficient (as it may seeme by the perpetuall course of that Catalogue) to come within fiue or ten minutes of the truth.

But to returne againe to that from whence wee haue

haue a little digreſſed. After this manner now ſhewed, we found the time of the Sunnes entrance into the beginning of ♈ and ♎, and into the midſt of ♉, ♌, ♏, and ♒, as into places ſeruing moſt fitly for finding out of the Suns eccentricitie and apogeum: following alſo herein the example of *Copernicus*, *lib.3.cap.16.Reuol.* who well perceiuing how hard, yea rather impoſſible a thing it is, to finde by obſeruation the time of the Sunnes entrance into the ſolſtitiall points (where the meridian altitudes, and declinations of the Sunne continue almoſt the ſame, without any ſenſible difference for two or three daies together) choſe rather the parts of the Zodiack alreadie mentioned, where the place of the Sunne may more truly be knowne by reaſon of the quicker altering of his declination, the difference thereof in the ſpace of 24 houres amounting to more then 17 min. The times therefore of the Suns comming to the foreſaid points in the yeeres 1594, 1595, 1596, 1597, wee found to be ſuch as are ſet downe in the table following.

	1594			1595			1596			1597				
	Da.	Ho.	Mi.	Da.	Ho.	Mi.	Da.	Ho.	Mi.	Da.	Ho.	Mi.	Sig	De.
Ian.				24	17	35	25	0	7	24	5	54	♒	15
Mar.				10	13	26	9	18	43	10	0	37	♈	0
April.				25	16	50	24	21	47	25	3	54	♉	15
July.	28	15	35	28	20	4	28	1	43	28	9	56	♌	15
Sept.	13	2	45	13	7	39	12	13	48	12	19	15	♎	0
Octob.	28	5	46	28	9	36	27	15	23	272	1	50	♍	15

Hereby the times of the Sunnes continuance in the arks of the Zodiack betwixt thoſe points, as alſo the

the arkes of the eccentrick answerable to those times, were more easily found then that it should now be needfull for me to be further tedious, in setting downe the manner of finding the same, wherein notwithstanding there may some difference of an houre or two sometimes appeare, by comparing together those times in seuerall yeeres: yet this error being such as may arise by missing little more then one minute in one obseruation: or little more then halfe a minute in two obseruations of the meridian altitudes of the Sunne (one obseruation being made when the Sunne is about the beginning of the arke, the other when he is about the ending thereof) I make no doubt, but that it shall at the least be fauourably censured by them that haue acquainted themselues with some practise of obseruing: wherein hee shall (in my opinion) quit himselfe meetly well, who neither through imperfection of sense, either in making or diuiding, or in rectifying, or in vsing his instrument, and euery part thereof: nor through the difficultie of noting precisely the edges of the shadow of the vpper sight falling vpon the nether: (the limits or bounds of which shadow are but a confused mixture (as it were) of light and darknesse, or else a meane equally compounded of them both, which can no better bee discerned then by ghessing:) nor yet by refraction of the Sunbeames through the thicknes of the aire, especially when the Sunne is in the Southerly semicircle of the Zodiack, which refraction admitteth some alteration, according to the diuersitie of the raritie or densitie of the vapours in the aire interposed betwixt

twixt our sight and the Sunne; he shall (I say) quit himselfe well, that neither by one, nor some, nor all these, shall misse a minute and more sometimes in obseruing the meridian altitude of the Sun: whereby if error be committed both at the beginning and ending of the foresaid arkes (especially of those arks that are conteined betweene the midst of *Taurus* and *Leo*, of *Leo* and *Scorpio*, of *Scorpio* and *Aquarius*, of *Aquarius* and *Taurus*) the place of the Sun found by such obseruation, may bee more or lesse then truth by three or foure minutes, and both errors together may amount to six or eight min. error in the motion of the Sunne, whereof may follow two or three houres error in the time of the Suns abiding in one of those arkes.

Out of the former table I found (by the obseruations of the two last yeeres especially) that the time of the Sunnes reuolution through the Zodiack in our time, is 365 daies, 5 houres, and about 48. min. Also the time of the Suns continuance in the Northerly semicircle of the Ecliptick, from the beginning of *Aries* to the beginning of *Libra*, to be 186 daies, 18 houres, and about one halfe: and consequently in the Southerly semicircle from *Libra* to *Aries*, 178 daies, 11 houres, 18 minutes: whereby the arkes of the Sunnes eccentrick, answerable to those semicircles, appeared to be 184 degrees, 5 min. 25 sec. from *Aries* to *Libra*, and 175 degrees, 54 min. 35 sec. from *Libra* to *Aries*.

Therefore becausse the place of the Sunne being at, or neere the æquinoctiall points, is most certainly knowne (his meridian altitude and declination altering

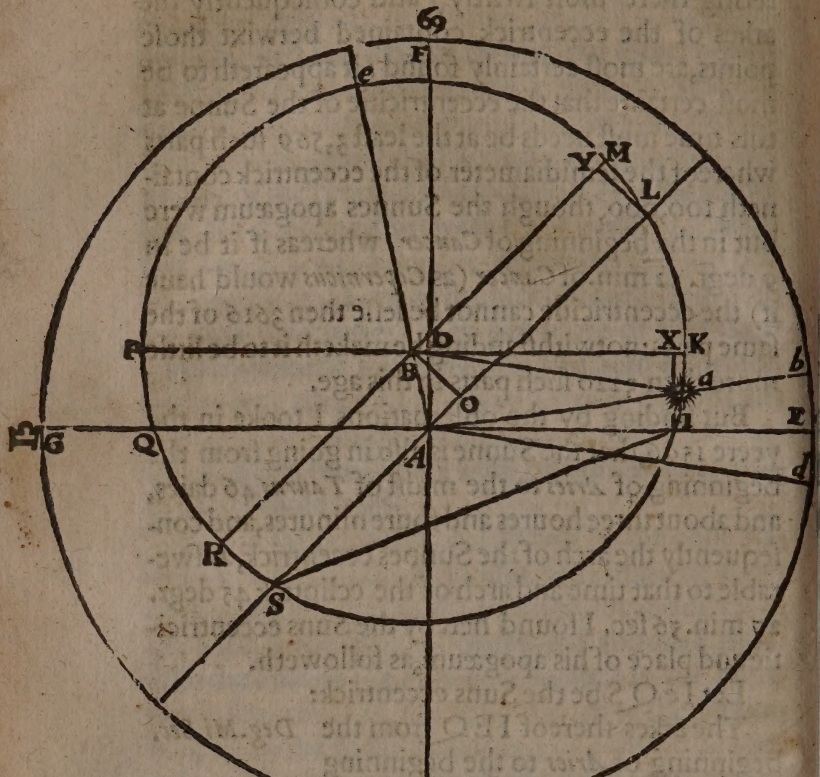
tering there moſt ſwiftly) and conſequently the arkes of the eccentrick contained betwixt thoſe points, are moſt certainly found: it appeareth to be moſt certaine that the eccentricitie of the Sunne at this time muſt needs be at the leaſt 3,569 ſuch parts whereof the ſemidiameter of the eccentrick containeth 100,000, though the Sunnes apogæum were but in the beginning of *Cancer*: whereas if it be in 9 degr. 22 min. of *Cancer* (as *Copernicus* would haue it) the eccentricitie cannot be leſſe then 3616 of the ſame parts: notwithſtanding he maketh it to be little more then 3220 ſuch parts in this age.

But finding by the obſeruations I tooke in the yeere 1596, that the Sunne is alſo in going from the beginning of *Aries* to the midſt of *Taurus* 46 daies, and about three houres and foure minutes, and conſequently the arch of the Sunnes eccentrick, anſwerable to that time and arch of the ecliptick 45 degr. 27 min. 56 ſec. I found hereby the Suns eccentricitie and place of his apogæum, as followeth.

Let I e Q S be the Suns eccentrick:

	Deg. Mi. Sec.
The arkes thereof I E Q from the beginning of *Aries* to the beginning of *Libra*	184 - 5 - 26
Q S I from the Sunnes entrance into *Libra* to his entrance into *Aries*	175 - 54 - 34
and I L from the beginning of *Aries* to the midſt of *Taurus*	45 - 27 - 56
the halfe whereof is the angle I S L	22 - 43 - 58.
Alſo the angle I A L from the beginning of *Aries* to the 15 of *Taurus*	45 - 0 - 0
The complement whereof to a ſemicircle is the angle I A S	135 - 0 - 0

which



	Deg. Mi. Sec.
which added to the angle I S A, makes	157-43-58
the complement whereof to a semi-circle is the angle A I S	22-16-2
the double wherof is the arch of the eccentrick S Q	44-32-4:
which taken out of Q S I	175-54-34

there

Deg.Mi.Sec.

there remaineth the arch S I ——— 131-22-30
the ſubtenſe whereof S I is ——— 18,226,268
whereof the whole ſine conteineth — 10,000,000
And this arch added to I L, maketh the
whole arch S I L ——— 176-50-26
the cõplement hereof to a ſemicircle is — 3-9-34
and the halfe of this complement is the
arch L M ——— 1-34-47
the ſine whereof is the line O B ——— 275,678
Moreouer, the halfe of the arch S I L is — 88-25-13
the ſine whereof is the line S A O ——— 9,996,199

Now in the triangle S I A, becauſe the ſides are proportionall to the ſines of the oppoſite angles: therefore as the ſine of the angle S A I — 7,071,068, is to the ſide S I ——— 18,226,268: ſo is the ſine of the angle S I A ——— 3,789,268, to the ſide S A ——— 9,842,653: which takẽ out of S A O, there is left A O 229,044
which hath the ſame proportion to — 10,000,000
that the right line O B ——— 275,678
hath to ——— 12,036,028
which is the tangent of the angle B A O — 50-16-42
the diſtance of the Suns apogæum from
the midſt of *Taurus*; that is, from the be-
ginning of *Cancer*; ——— 5-16-42
which, to auoid ſcrupuloſitie, we wil make 5-17-0
the ſine whereof ——— 7,692,137
is to the whole ſine ——— 10,000,000
as the right line O B ——— 275,678
is to B A the Sunnes eccentricitie ——— 358,388
wherof B E, the radius of ỹ eccentrick, is 10,000,000

Which may yet alſo be more eaſily found by the Tetragonicall table, or table of Rootes and ſquares, for taking A O and O B to be 2290, and 2757, their ſquares will be 5,244,100, and 7,601,049; which added together make 12,845,149, the ſquare roote or ſide whereof is 3584, the Sunnes eccentricitie, in ſuch parts whereof the ſemidiameter of the eccentrick B e conteineth 100,000, agreeing exactly with the Sunnes eccentricitie, found by *Tycho Brahe Progymnaſmat. pag. 26.*

The ſame may alſo be further confirmed thus: We haue found the arch of the Sunnes eccentrick from the beginning of *Aries* to the beginning of

	Deg. Mi. Sec.
Libra, to be	184-5-26,
the exceſſe wherof aboue a ſemicircle is	4-5-26,
the halfe of this is the arch I K	2-2-43,
the ſine whereof I X (equall to A D) is	356,892
(whereof the ſemidiameter of the eccentrick is	10,000,000)

which ſhould be the Suns eccentricitie, if his apogæum were in the beginning of *Cancer*. But hauing found that the Suns apogæũ is about 5 deg. 17 min. of *Cancer*; therfore as the whole ſine 10,000,000 is to the ſecant of 5 degr. 17 min. 10,042,667 ſo is A D in the right angled triangle A D B 356,892 to A B the eccentricitie of the Sun 358,414, which hath not any ſenſible difference from that we found before.

But the place of the Sunnes apogæum, found by the foreſaid obſeruations, differeth from *Tycho* twentie minutes (if we adde to his place of the apogæum

gæum of the Sunne 7 minutes, for the motion of the Sunnes apogæum in the tenne yeeres ſpace betwixt his obſeruation and mine). All which difference notwithſtanding may ariſe by erring little more then halfe a quarter of a minute in obſeruing the Suns height about the midſt of *Taurus*. Which error although it be ſo ſmall that it may worthily be neglected, for whether of them ſoeuer you follow, either his (apogæum) or mine, for the making of the Ephemerides and tables enſuing, there cannot hereof ariſe any ſuch diſagreement as can by ſight be diſcerned: yet in that ſmall difference that is, (though inſenſible) I ſhal not vnwillingly yeeld vnto him, conſidering with how great preparation, coſt, skill, diligence, and circumſpection euery way he went about this buſineſſe: as all they that haue any iudgement and vſe of obſeruation will eaſily grant. I ſay therefore not building only vpon his authoritie (though in this kinde it be greater then any others, yet knowne to the world) that (following the ordinarie receiued hypotheſis of an eccentrick, for ſaluing the Sunnes apparent inequalitie of motion) the Suns eccentricitie & place of his apogæũ, ſet downe by *Tycho*, as before we haue ſhewed, are in this our age very agreeable to truth, and without al ſuch error as can by ſenſe be diſcerned. And as for ẏ difference that ſeemeth to be betwixt vs, being ſo ſmall and inſenſible; ſo farre ought it to be from breeding doubtfulnes in any, that it may rather make not a little for the confirmation of the truth both of his and my obſeruations; ſo as none ſhall need to make ſcruple of the certeintie and infallibi-

litie of those tables of the Suns declination, which for the Nauigators vse shall out of these grounds be gathered and diduced.

Chap. XXI.

The middle motion of the Sunne, corrected out of the former obseruations.

THE eccentricitie therefore and apogeum of the Sun being thus knowne, together with his true place (which by so exact obseruation as we could in the yeere 1597, the 11 of March at noone, we found to be 0 degr. 57 min. 48 sec. of *Aries:*) his middle motion from the beginning of *Aries* was also easily found after this manner:

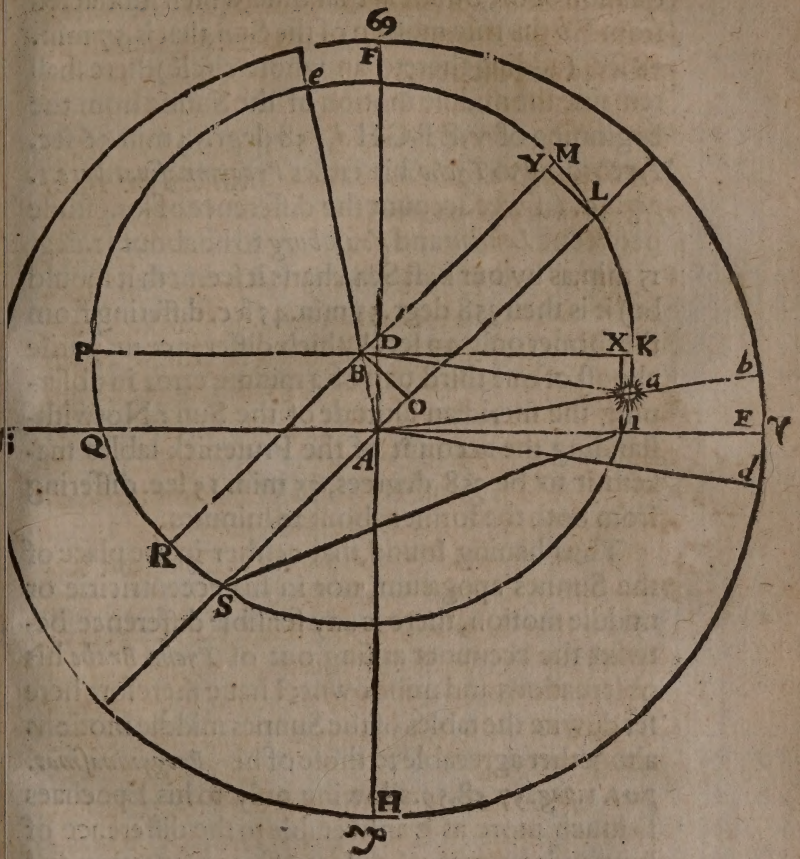
Let *a* be the place of the Sunne in his eccentrick; *b* the Suns true place in the Zodiack.

B *a* a line drawne from the center of the eccentrick to the center of the Sunne.

A *d* a line drawne frō the center of the ecliptick parallel to B *a*, shewing the middle place of the Sun in the Zodiack.

A B, a line drawne frō the center of the ecliptick, by the center of the Sunne to the Zodiack, shewing the true place of the Sunne.

Therefore the angle B A D being 5 degr. 37 min. and consequently the angle B A I 95 degr. 37 min. because D A I is a right angle: the angle *a* A I, found by obseruation to be 0 degrees, 57 min. 48 seconds, being subtracted from the angle B A I, there shall remaine the angle B A *a* in the triangle B A *a* 94 degr. 39. min.



39 min. 12 sec. and two sides also of the same triangle being giuen, a B 100, 000 parts, and B A 3584 of the same parts, therefore by the doctrine of triangles, the angle B a A equall to a A d (because B a, and A D are parallels) shall likewise be found to be 2 degrees, 2 min. 52 sec. (the prosthaphæresis or æ-

quation of the Sunne at that time, which ſubtracted from E *b* the true motion of the Sun, that is, 57 min. 58 ſec. (adding thereto an whole circle) there ſhall remaine the middle motion of the Sunne from the beginning of ♈, E F G H *d*, 358 degr. 54 min. 56 ſec. According to *Tycho* his tables *Progymnaſmat. part.* 1. *pag.* 59. (if wee account the difference of longitude betweene *London* and *Vraniburg* to be about 11. deg. 15 min. as by our beſt Sea-charts it ſeemeth it ſhould be) it is then 358 degr. 55 min. 45 ſec. differing from the former only 49 ſec. Which difference may ariſe almoſt of one third part of a minute error in obſerving the meridian altitude of the Sun: Notwithſtanding the account of the Prutenick tables maketh it to be 358 degrees, 35 min. 15 ſec. differing from both the former about 20 minutes.

Thus hauing found, that neither in the place of the Sunnes apogæum, nor in his eccentricitie or middle motion, there is any ſenſible difference betwixt the accounts ariſing out of *Tycho Brahe* his obſeruations and mine owne; I haue therefore here ſet downe the tables of the Sunnes middle motions altogether agreeable to thoſe of his; *Progymnaſmat. part.* 1. *pag.* 57. 58. 59. allowing only to his Epochaes ſo much more as is anſwerable to the difference of longitude between the place of his obſeruation and mine, that is, to the Epochaes of the Sunnes middle motion of longitude, 1 min. 52 ſec. anſwering to 45 min. of an houre almoſt, or 11 degr. and $\frac{1}{4}$, that is, ſo much as the citie of *London* ſeemeth to bee more Weſterly then *Vraniburg*.

EPO-

EPOCHAES OF THE MIDDLE MOTIONS OF THE SVNS

	Apogæum.	*Longitude.*
Yeares	*Si. P. Mi. Se.*	*Si. P. Mi. Se.*
1500	3 4 24 45	9 20 10 52
1520	3 4 39 45	9 20 20 6
1540	3 4 54 45	9 20 29 20
1560	3 5 9 45	9 20 38 35
1580	3 5 24 45	9 20 47 49
1600	3 5 39 45	9 20 57 4
1601	3 5 40 30	9 20 42 44
1602	3 5 41 15	9 20 28 25
1603	3 5 42 0	9 20 14 6
1604	3 5 42 45	9 20 58 54
1605	3 5 43 30	9 20 44 35
1606	3 5 44 15	9 20 30 16
1607	3 5 45 0	9 20 15 56
1608	3 5 45 45	9 21 0 45
1609	3 5 46 30	9 20 46 26
1610	3 5 47 15	9 20 32 7
1611	3 5 48 0	9 20 17 47
1612	3 5 48 45	9 21 2 36
1613	3 5 49 30	9 20 48 17
1614	3 5 50 15	9 20 33 58
1615	3 5 51 0	9 20 19 38
1616	3 5 51 45	9 21 4 7
1617	3 5 52 30	9 20 50 8
1618	3 5 53 15	9 20 35 48
1619	3 5 54 0	9 20 21 29
1620	3 5 54 45	9 21 6 18
1621	3 5 55 30	9 20 52 1
1622	3 5 56 15	9 20 37 39
1623	3 5 57 0	9 20 23 20
1624	3 5 57 45	9 21 8 9
1625	3 5 58 30	9 20 53 50
1626	3 5 59 15	9 20 39 30
1627	3 6 0 0	9 20 25 11
1628	3 6 0 45	9 21 10 0
1629	3 6 1 30	9 20 55 40
1630	3 6 2 15	9 20 41 21
1631	3 6 3 0	9 20 27 2
1632	3 6 3 45	9 21 11 51

Middle motions in single yeeres vntill 20.

1	0 0 0 45	11 29 45 41
2	0 0 1 30	11 29 31 21
3	0 0 2 15	11 29 17 2
4	0 0 3 0	0 0 1 51
5	0 0 3 45	11 29 47 32
6	0 0 4 30	11 29 33 12
7	0 0 5 15	11 29 18 53
8	0 0 6 0	0 0 3 42
9	0 0 6 45	11 29 49 22
10	0 0 7 30	11 29 35 3
11	0 0 8 15	11 29 20 44
12	0 0 9 0	0 0 5 33
13	0 0 9 45	11 29 51 13
14	0 0 10 30	11 29 36 54
15	0 0 11 15	11 29 22 35
16	0 0 12 0	0 0 7 24
17	0 0 12 45	11 29 53 4
18	0 0 13 30	11 29 38 45
19	0 0 14 15	11 29 24 26
20	0 0 15 0	0 0 9 14

THE SVNS EQVAL MOTION OF LONGITVDE.

In moneths of the common yeere.	S.	D.	M.	Se.
Ianu.	1	0	33	18
Febr.	1	28	9	11
Mar.	2	28	42	30
April.	3	28	16	39
May.	4	28	49	58
Iune.	5	28	24	7
Iuly.	6	23	57	26
Aug.	7	29	30	44
Sept.	8	29	4	54
Octob.	9	29	38	12
Nou.	10	29	12	22
Dec.	11	29	45	40

In moneths of the leape yeere.	S.	D.	M.	Se.
Ianu.	1	0	33	18
Febr.	1	29	8	20
Mar.	2	29	41	38
April.	3	29	15	48
May.	4	29	49	6
Iune.	5	29	23	16
Iuly.	6	29	56	34
Aug.	8	0	29	53
Sept.	9	0	4	3
Octob.	10	0	37	21
Nou.	11	0	11	31
Dec.	0	0	44	49

In Moneths.

In daies.	Da	De.	Mi.	Se.
	1	0	59	8
	2	1	58	17
	3	2	57	25
	4	3	56	33
	5	4	55	42
	6	4	54	50
	7	6	53	58
	8	7	53	7
	9	8	52	15
	10	9	51	23
	11	10	50	32
	12	11	49	40
	13	12	48	48
	14	13	47	57
	15	14	47	5
	16	15	46	13
	17	16	45	21
	18	17	44	30
	19	18	43	38
	20	19	42	47
	21	20	41	55
	22	21	41	3
	23	22	40	12
	24	23	39	20
	25	24	38	28
	26	25	37	37
	27	26	36	45
	28	27	35	53
	29	28	35	1
	30	29	34	10
	31	30	33	18

In houres.	H	Mi.	S
	1	2	28
	2	4	56
	3	7	24
	4	9	51
	5	12	19
	6	14	47
	7	17	15
	8	19	34
	9	22	11
	10	24	38
	11	27	6
	12	29	34
	13	32	2
	14	34	30
	15	36	58
	16	39	26
	17	41	53
	18	44	21
	19	46	49
	20	49	17
	21	51	45
	22	54	13
	23	56	40
	24	59	8

In houres.

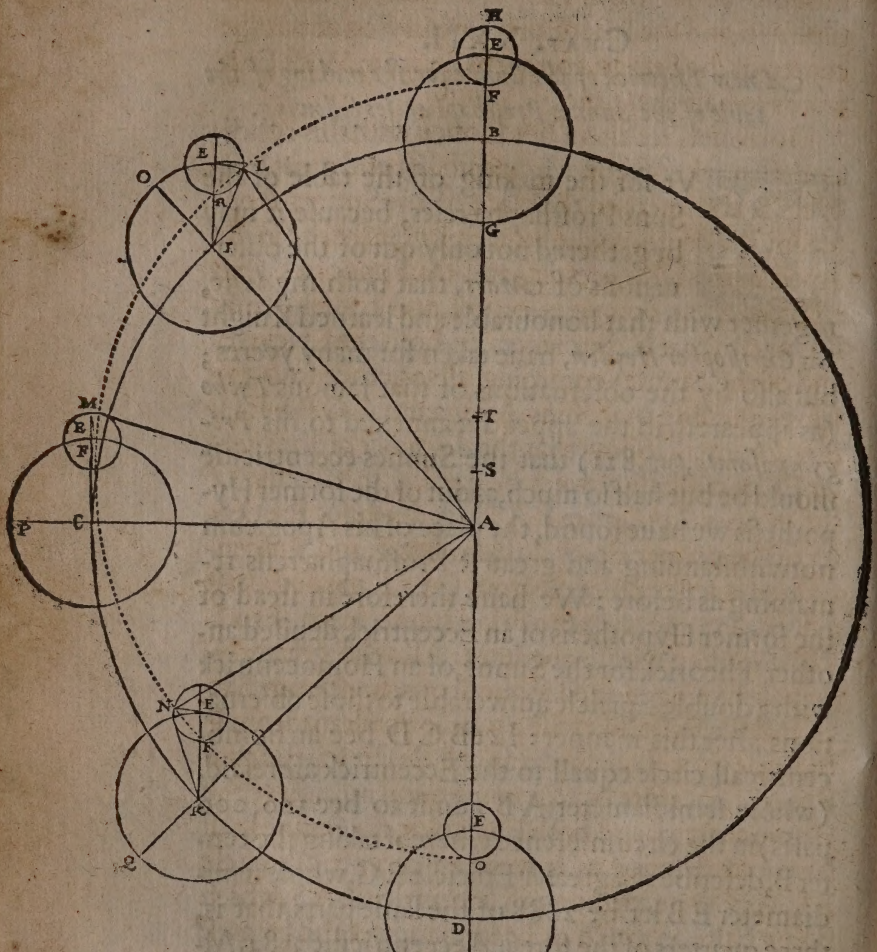
In minutes.	M.	M.S.	M.	M.S.
	0	0	30	1 14
	1	0 2	31	1 16
	2	0 5	32	1 19
	3	0 7	33	1 21
	4	0 10	34	1 24
	5	0 12	35	1 26
	6	0 15	36	1 29
	7	0 17	37	1 31
	8	0 20	38	1 34
	9	0 22	39	1 36
	10	0 25	40	1 39
	11	0 27	41	1 41
	12	0 30	42	1 43
	13	0 32	43	1 46
	14	0 34	44	1 48
	15	0 37	45	1 51
	16	0 39	46	1 53
	17	0 42	47	1 56
	18	0 44	48	1 58
	19	0 47	49	2 1
	20	0 49	50	2 3
	21	0 52	51	2 6
	22	0 54	52	2 8
	23	0 57	53	2 11
	24	0 59	54	2 13
	25	1 2	55	2 15
	26	1 4	56	2 18
	27	1 7	57	2 20
	28	1 9	58	2 23
	29	1 11	59	2 25
	30	1 14	60	2 28

Chap. XXII.

A new Theorick of the Sunne for the making of the table of the Sunnes Prosthaphæreses following.

BVt for the making of the table of the Suns Prosthaphæreses, becauſe it may be gathered not only out of the obſeruations of *Mars*, that both my ſelfe, together with that honourable and learned Knight Sir *Chriſtopher Heydon*, haue taken for many yeeres; but alſo by the obſeruations of that famous *Tycho* (as appeareth in the appendix annexed to his *Progymnaſmata*, *pag.* 821) that the Sunnes eccentricitie ſhould be but halfſo much, as out of the former Hypotheſis we haue found, the place of his Apogæum notwithſtanding and greateſt Prosthaphæreſis remaining as before: We haue therefore in ſtead of the former Hypotheſis of an Eccentrick deuiſed another Theorick for the Sunne, of an Homocentrick with a double Epicicle anſwerable to thoſe obſeruations after this manner: Let B C D bee an homocentricall circle equall to the Eccentrick aforeſaid, (whoſe ſemidiameter A B admit to bee 100,000 parts) in the circumference whereof taking the center B, deſcribe the greater Epicicle E G, whoſe ſemidiameter E B let be 2688 of the ſame parts, that is, three quarters of the foreſaid eccentricitie 3584. Alſo vpon the center E, taken in the greater Epicicle, deſcribe the little Epicicle F H, and let the radius or ſemidiameter thereof E H be 896 ſuch parts, that is, one quarter of the former eccentricitie of the Eccentrick. Let all theſe circles be moued about their

owne



owne centers equally; the homocentrick carrying about the center of the greater Epicycle from the West Eastwards in the time that the Sunne returneth againe to his Apogæum; the greater Epicycle mouing

mouing about from East Westward in the same time also, and the lesser Epicycle carrying about the center of the Sunne contrariwise from West Eastwards in half that time.

Moreouer, let them bee moued with this condition, that whensoeuer the center of the great Epicycle B, commeth to the place of the Sunnes Apogæum, the center of the little Epicycle shal be in the Apogæum of the greater, and the Sunne in F next to B the great Epicycles center, and consequently B E and F (that is, the centers of both the Epicycles and of the Sunne) comming all together into the same right line of ỹ Suns Apogæum A G B F E H. Hereof it will follow that the diameter of the greater Epicycle shall alwaies be parallel to the line of the Sunnes Apogæum B A D, and whiles the center of the greater Epicycle from B to I, and the center of the lesser Epicycle from O to E moueth half a quadrant, the center of the Sunne from R to L shall moue an whole quadrant. Also the greater Epicycle hauing moued a whole quadrant from B to C, and the lesser likewise a whole quadrant from P to E, the Sun shall moue an whole semicircle from F to M. Therfore by this compound motion of the Homocentrick and both Epicycles, the Sunne shall seeme to describe as it were an eccentricall circle F L M N O, according to ỹ eccentricitie A S, which is but halfe so much as before, and yet the greatest Prosthaphæresis M A C, shall be the same almost as before, according to the Hypothesis of a simple eccentrick, whose eccentricitie were A T.

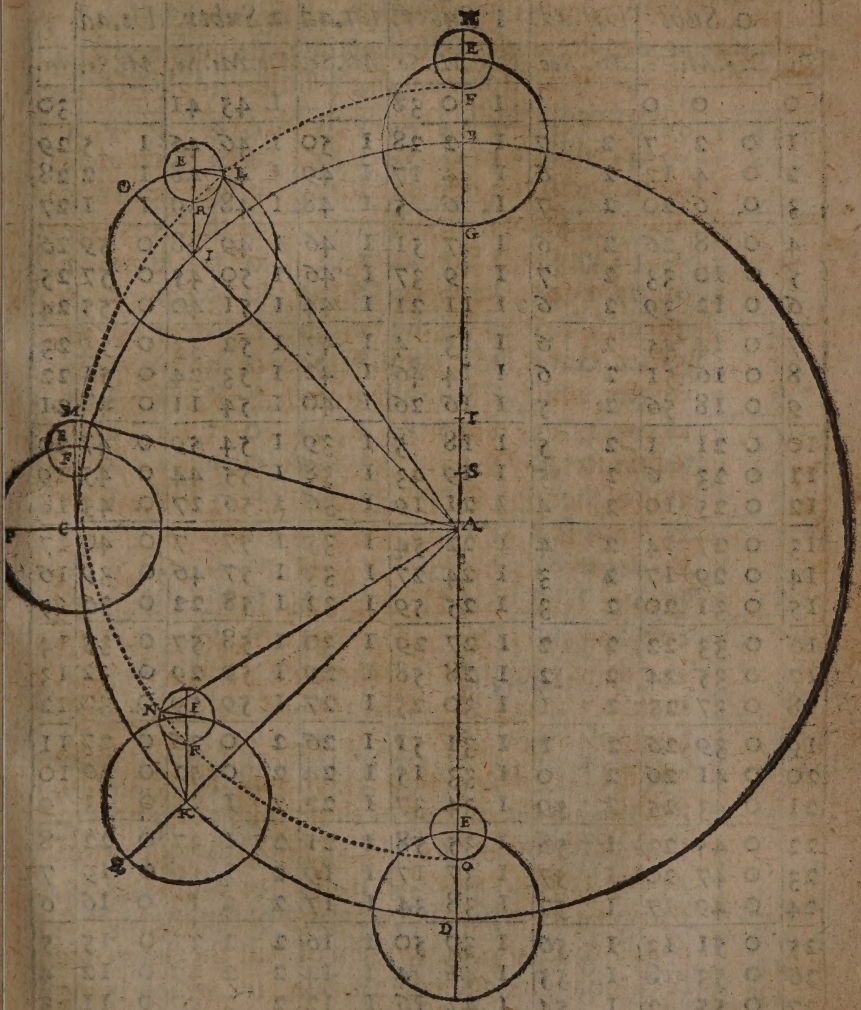
According to this Hypothesis was made the table of Prosthaphæreses here following, to euery degree of the Suns Anomalie, and that after this manner:

Admit

The making of the table of the Sunnes Prosthaphæreses.

Admit the angle B A I of the Sunnes middle motion from his Apogæum be 30 degrees: hereby are giuen the angles OIE likewise 30 degrees, and REL 60 degrees. Moreouer, in the little triangle EIL, the two sides including this angle, being also giuen, that is IE 2688, and EL 896, such parts whereof I A conteineth 100,000: therfore as the summe of these sides 3584 is to their difference 1792, that is, as 2 is to 1, so is 17,320,508 the tangent of half the summe of the two opposite angles ELI and LIE (that is 60 degrees) to 8,660,254, the tangent of 40 degr. 53 min. 36 sec. that is, halfe the difference of those opposite angles, which subducted from halfe the summe 60 degrees, there remaineth the angle EIL 19. degrees, 6 minutes, 24 seconds. Moreouer, as 3,273,278, the sine of the angle L I E 19 deg. 6 min. 24 sec. is to EL 896: so is 8,660,254, the sine of the angle I E L 60 degrees to the side L I 2370. Now then in the greater triangle A I L two sides being giuen A I 100,000, and I L 2370, together with the angle L I A 130 degr. 53 min. 36 sec. (becauſe it is the complement of the angle O I L to a semicircle, which angle being compounded of the angles O I E, 30 degr. and E I L 19 degr. 6 min. 24 sec. is 49 deg. 6 min. 24 seconds) as the summe of those sides 102,370 is to their difference 97,630, so is 45,685 (the tangent of 24 deg. 33 min. 12 sec. that is, the half of 49 degrees, 6 min. 24 sec. which is the summe of the angles at A and L) to 43,570, the tangent of half the difference of those angles 23 deg. 32 min. 24 sec. which being take out of half the summe of them 24 deg. 33 min. 12 sec. there remaineth 1 degr. 0 min. 38 sec. the Suns Prosthaphæresis, when his motion of Anomalie or middle distance from his Apogæum is 30 degrees.

Thus



Thus we may finde the Sunnes Prosthaphæreses for euery degree of his Anomalie, and so make this table following.

De.	0 Subt. Deg. Mi. Se.	Dif.ad. Mi. Sec.	1 Subtr. Deg. Mi. Se.	Di.ad Mi. Se.	2 Subtr. De. Mi. Se.	Di.ad Mi. Se.	De.
0	0 0		1 0 38		1 45 41		30
1	0 2 7	2 7	1 2 28	1 50	1 46 46	1 5	29
2	0 4 13	2 6	1 4 17	1 49	1 47 48	1 2	28
3	0 6 20	2 7	1 6 5	1 48	1 48 49	1 1	27
4	0 8 26	2 6	1 7 51	1 46	1 49 48	0 59	26
5	0 10 33	2 7	1 9 37	1 46	1 50 45	0 57	25
6	0 12 39	2 6	1 11 21	1 44	1 51 40	0 55	24
7	0 14 45	2 6	1 13 4	1 43	1 52 33	0 53	23
8	0 16 51	2 6	1 14 46	1 42	1 53 24	0 51	22
9	0 18 56	2 5	1 16 26	1 40	1 54 11	0 48	21
10	0 21 1	2 5	1 18 5	1 39	1 54 59	0 47	20
11	0 23 6	2 5	1 19 43	1 38	1 55 44	0 45	19
12	0 25 10	2 4	1 21 19	1 36	1 56 27	0 43	18
13	0 27 14	2 4	1 22 54	1 35	1 57 7	0 40	17
14	0 29 17	2 3	1 24 27	1 33	1 57 46	0 39	16
15	0 31 20	2 3	1 25 59	1 32	1 58 22	0 36	15
16	0 33 22	2 2	1 27 29	1 30	1 58 57	0 35	14
17	0 35 24	2 2	1 28 58	1 29	1 59 29	0 32	13
18	0 37 25	2 1	1 30 25	1 27	1 59 59	0 30	12
19	0 39 26	2 1	1 31 51	1 26	2 0 26	0 27	11
20	0 41 26	2 0	1 33 15	1 24	2 0 52	0 26	10
21	0 43 25	1 59	1 34 37	1 22	2 1 15	0 23	9
22	0 45 23	1 58	1 35 58	1 21	2 1 37	0 22	8
23	0 47 20	1 57	1 37 17	1 19	2 1 56	0 19	7
24	0 49 17	1 57	1 38 34	1 17	2 2 12	0 16	6
25	0 51 13	1 56	1 39 50	1 16	2 2 27	0 15	5
26	0 53 8	1 55	1 41 4	1 14	2 2 39	0 12	4
27	0 55 2	1 54	1 42 16	1 12	2 2 50	0 11	3
28	0 56 55	1 53	1 43 26	1 10	2 2 58	0 8	2
29	0 58 47	1 52	1 44 34	1 8	2 3 3	0 5	1
30	1 0 38	1 51	1 45 41	1 7	2 3 7	0 4	0
D.	11 Add.	Dif. S.	10 Add.	Dif.S.	9 Add.	Dif.S.	D.

	3 Subtr.	Dif. S.	4 Subtr.	Dif. S.	5. Subtr.	Dif. S.	
De.	Deg. Mi. Se	Mi. Sec.	Deg. Mi. Se	Mi. Se.	De. Mi. Se.	Mi. Se.	De.
0	2 3 7		1 47 35		1 2 33		30
1	2 3 8	0 1	1 46 31	1 4	1 0 39	1 54	29
2	2 3 7	0 1	1 45 25	1 6	0 58 45	1 54	28
3	2 3 3	0 4	1 44 17	1 8	0 56 49	1 56	27
4	2 2 58	0 5	1 43 7	1 10	0 54 52	1 57	26
5	2 2 50	0 8	1 41 54	1 13	0 52 55	1 57	25
6	2 2 40	0 10	1 40 40	1 14	0 50 56	1 59	24
7	2 2 28	0 12	1 39 24	1 16	0 48 56	2 0	23
8	2 2 13	0 15	1 38 7	1 17	0 46 55	2 1	22
9	2 1 56	0 17	1 36 47	1 20	0 44 53	2 2	21
10	2 1 37	0 19	1 35 25	1 22	0 42 51	2 2	20
11	2 1 16	0 21	1 34 2	1 23	0 40 47	2 4	19
12	2 0 52	0 24	1 32 37	1 25	0 38 43	2 4	18
13	2 0 27	0 25	1 31 10	1 27	0 36 38	2 5	17
14	1 59 59	0 28	1 29 42	1 28	0 34 33	2 5	16
15	1 59 28	0 31	1 28 11	1 31	0 32 26	2 7	15
16	1 58 56	0 32	1 26 39	1 32	0 30 19	2 7	14
17	1 58 21	0 35	1 25 6	1 33	0 28 12	2 7	13
18	1 57 44	0 37	1 23 30	1 36	0 26 4	2 8	12
19	1 57 5	0 39	1 21 54	1 36	0 23 55	2 9	11
20	1 56 24	0 41	1 20 15	1 39	0 21 46	2 9	10
21	1 55 41	0 43	1 18 35	1 40	0 19 37	2 9	9
22	1 54 55	0 46	1 16 54	1 41	0 17 27	2 10	8
23	1 54 8	0 47	1 15 11	1 43	0 15 17	2 10	7
24	1 53 18	0 50	1 13 27	1 44	0 13 6	2 11	6
25	1 52 26	0 52	1 11 41	1 46	0 10 56	2 10	5
26	1 51 32	0 54	1 9 54	1 47	0 8 45	2 11	4
27	1 50 36	0 56	1 8 6	1 48	0 6 34	2 11	3
28	1 49 38	0 58	1 6 16	1 50	0 4 23	2 11	2
29	1 48 38	1 0	1 4 25	1 51	0 2 11	2 12	1
30	1 47 35	1 3	1 2 33	1 52	0 0 0	2 11	0
	8 Add.	Dif. ad.	7 Add.	Di. ad	6. Add.	Di. ad.	

Chap. XXIII.

The making of the Ephemerides of the Sunne here following.

With helpe of the two former tables of the Suns middle motions and of his prosthaphæreses, the Suns true place may be readily found, and so the Ephemerides following easily made, after this manner: Reduce the apparent time giuen to the equall time answering thereto, with helpe of *Tycho Brahe* his table of æquation of naturall daies; and for that time so reduced adde together the Suns middle motions of longitude in yeeres, moneths, daies, houres, and minutes: out of the summe subtract the place of the Sunnes apogæum; the remainder shall be the Suns motion of Anomalie, or his distance from his apogæum.

Now if this Anomalie be lesse then a semicircle, looke the signe thereof in the head of the table of the Sunnes prosthaphæreses, and the degree in the first columne towards the left hand descending, and proceed in the same line towards the right hand, till you come vnder the foresaid signe of the Suns Anomalie, for there shall you haue the Sunnes prosthaphæresis for that time; remembring this withal, that if there be any minutes adhering to those degrees of Anomalie, that prosthaphæresis must be corrected by the part of the adiacent difference proportionall to those minutes, adding or subtracting the same hereto: according as you are directed in the head of the columne, wherein that difference is set down.

But

But if the Suns Anomalie be more then a semicircle, you must finde the signes thereof in the foote of the table, and the degrees in the last columne next the right hand ascending, and in the common meeting of the line wherein you finde this degree, and of the columne of the said signe of the Sunnes Anomalie, you shall finde the Sunnes Prosthaphæresis, as before; which if there be any minutes adherent to the Sunnes Anomalie, must be corrected by the part proportionall of the difference adioyning, as before; adding or subtracting the same, according as you finde your direction in the foote of the columne conteining that difference.

As for example: Suppose you would know the Suns true place the 6 of May at noone (that is, the 5 of May complete according to Astronomicall account) in the yeere 1608, which time reduced to equalitie by the foresaid table, shall be the 4 of May complete 23 houres, 48 minutes: for the Sun being at that time about the 26 degree of *Taurus*, that table sheweth you that 12 minutes are to be subtracted from the apparent time to make it equall. For this time therefore let the middle motions of the Sunne be gathered together in this manner:

		Si.	*D.*	*M.*	*Se.*
The Suns middle motion of longitude for	the yere of Christ 1607 complete,	9	20	15	56
	Foure moneths of the leape yeare,	3	29	15	48
	Foure daies,		3	56	33
	23 houres,			56	40
	48 minutes.			1	58

	Si.	*D.*	*M.*	*Se.*
The ſumme of all theſe is the Suns middle motion of longitude for the time aforeſaid	1	24	26	55
The place of the Suns Apogæum for the yeare of Chriſt 1607 cõplete, is	3	5	45	0
The motion thereof in the moneths, daies, houres, &c. remaining, is				15
which put together, make the place of the Suns Apogæum for the time aforeſaid	3	5	45	15
This being ſubducted out of ỹ Suns middle motion,	1	24	26	55
there ſhall remaine the Suns motion of Anomalie	10	18	41	40
The Proſthaphæreſis anſwerable to 10 ſignes, 18 degr. you ſhall finde in the table of Proſthaphæreſes		1	21	19
with ỹ difference anſwering thereto			1	36
the part proportionall whereof anſwering to 41 min. 40 ſeconds, you ſhall finde to be			1	7
which ſubtracted out of the Proſthaphæreſis anſwering to 10 ſig. 18 de.		1	21	19
there remaineth the Proſthaphæreſis corrected		1	20	12
which being added to the Sunnes middle motion of longitude for the time aforeſaid	1	24	26	25
you ſhall haue the Sunnes true place for that time	1	25	47	7

agreeing iuſtly with the Ephemerides following, where you ſhall finde the Sunne at that time to be in 25 degr. 47 min. 7 ſec. of *Taurus*.

Admit

Admit also I would know the true place of the Sunne the 27 of October 1609 at noone, as we commonly account, (that is) for the 26 of October complete by the foresaid account Astronomicall, which reduced to the equall time, will make 25 daies, 23 houres, 36 min. The Suns middle motions therefore, together with the rest of the account, for finding the Sunnes true place for that time, may bee shortly gathered after this manner: 26.

		Si.	*D.*	*M.*	*Se.*
The Suns middle motion of longitude for	the yere of Christ 1608 complete,	9	21	0	45
	September of the cõmon yere, cõplete	8	29	4	54
	Fiue & twenty daies		24	38	28
	Twenty three houres			56	40
	Thirty six minutes			1	29
The summe of these is the Sunnes middle motion of longitude for that time:		7	15	42	14
From whence subtract the place of the Sunnes Apogæum,		3	5	46	18
there remaineth ỹ Suns Anomalie		4	9	55	56
whereby is found the Suns Prosthaphæresis			1	35	31
and by subtraction hereof, his true longitude,		7	14	6	45

agreeing likewise iustly with the Ephemerides following; after which manner also they may be wholly made. Notwithstanding it is sufficient to make some conuenient part of them in this manner, and (for sparing time and labour) to supplie the rest by

conuenient parts proportionall, whereof there may sometimes arise some small difference of a few seconds, which may worthily be neglected, seeing they can breed no sensible error in this businesse.

Chap. XXIIII.

How to reduce the apparent time to the equall time answering thereto.

NOtwithstanding the greatest difference betweene the apparent and equall time be so small, that by neglect thereof there can scarse at any time arise thereof so much as one minute error in the place of the Sun; and consequently not so much as half a minute error in his declination: yet because the rules and grounds of Arts ought so much as may be to be free from all error, I haue therefore thought it better here to set downe the foresaid table of æquation of naturall daies, rather then to leaue the Reader to seeke any further for so small a matter, if any perhaps shall be desirous to exercise himselfe in calculating the Sunnes true place, according to the manner heere before set downe, either for the examining of the Suns Ephemerides here following, or any other; or for making some other like to these, when the date of them shall be expired; wherein, if perhaps you find some little difference of a few seconds from your calculation, you need not therewith to be any thing troubled, seeing it cannot produce any sensible error, neither in the Suns declination, nor yet in his place.

This

A Table of the æquation of naturall daies.

	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
	S	S	S	S	S	S	S	S	S	S	A	A
De	M.	Mi.	Mi.	M.	M	Mi.	Mi.	Mi.	Mi.	Mi.	M.	M.
2	0	9	12	6	2	6	16½	24	21	7	5	7
4	1	9½	11	6	2	7	17	24	20	6	6	7
6	1	10	11	5½	2	7	18	24	19½	5	6	7
8	2	10	11	5	2	8	18	24½	19	4	6½	6½
10	3	11	11	5	2	9	19	24	18	3½	7	6
12	3	11	10	4	2	9	20	24	17	2½	7	6
14	4	11	10	4	3	10	20	24	16	2	7½	5
16	5	11	10	3½	3	11	21	24	15	1	8	5
18	5	11½	9	3	3	11½	21	24	14	0	8	4
20	6	12	9	3	3	12	22	23½	13½	A1	8	4
22	6	12	8½	3	4	13	22	23	12½	2	8	3
24	7	12	8	2½	4	13½	23	23	11½	3	8	2½
26	7½	12	8	2	5	14	23	22	10½	3	8	2
28	8	12	7	2	5	15	23	22	9½	4	8	1
30	8½	12	7	2	6	16	24	21	8½	5	7½	0½

This table must be thus vsed: With the signe and degree of the Suns true place take out in the common meeting the minutes of time; which according to the letters A, S, in the head of the table, must be added to or subtracted from the apparent time to make it equall: remembring to doe contrariwise if the equall time must bee changed into the apparent.

Chap. XXV.

A table of æquations of the Suns Ephemerides.

	Ianuary	Febr.	March.	Aprill.	May.	Iune.
Day.	Mi. Se.	Mi. Se.	Mi. Se.	Mi. Se.	Mi. Se.	Min. Se.
3	1 53	1 51	1 49	1 47	1 46	1 45
6	1 52	1 50	1 49	1 47	1 46	1 45
9	1 52	1 50	1 49	1 47	1 45	1 45
12	1 52	1 51	1 48	1 46	1 46	1 44
15	1 52	1 50	1 49	1 47	1 45	1 45
18	1 52	1 50	1 48	1 46	1 45	1 45
21	1 51	1 50	1 48	1 46	1 45	1 45
24	1 52	1 50	1 48	1 46	1 45	1 44
27	1 51	1 50	1 47	1 46	1 45	1 45
30	1 52		1 48	1 46	1 45	1 45

	Iuly.	August	Sept.	Octob.	Nouem.	Decem.
Day.	Mi. Se.	Mi. Se.	Mi. Se.	Mi. Se.	Mi. Se.	Min. Se.
3	1 45	1 45	1 48	1 49	1 51	1 52
6	1 45	1 46	1 48	1 50	1 52	1 52
9	1 45	1 46	1 48	1 50	1 52	1 52
12	1 45	1 46	1 48	1 50	1 52	1 53
15	1 45	1 47	1 49	1 50	1 52	1 52
18	1 45	1 47	1 48	1 51	1 52	1 52
21	1 45	1 47	1 49	1 50	1 52	1 52
24	1 46	1 47	1 49	1 51	1 52	1 53
27	1 46	1 47	1 49	1 51	1 52	1 52
30	1 45	1 47	1 49	1 52	1 53	1 52

By meanes of this table, and theſe Ephemerides, the true place of the Sun may moſt eaſily be found, for many yeares, either paſt, or to come; as ſhall hereafter be ſhewed in the next Chapter.

Leape yeare.	January. ♑			February. ♒			March. ♓		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	20	47	21	22	17	51	21	23	9
2	21	48	38	23	18	28	22	22	49
3	22	49	52	24	19	3	23	22	27
4	23	51	6	25	19	37	24	22	2
5	24	52	18	26	20	8	25	21	36
6	25	53	30	27	20	39	26	21	7
7	26	54	40	28	21	7	27	20	37
8	27	55	49	29	21	34	28	20	4
9	28	56	57	♓	21	59	29	19	28
10	29	58	5	♈	22	22	♉	18	51
11	♒	59	11	2	22	43	1	18	12
12	2	0	16	3	23	2	2	17	31
13	3	1	21	4	23	19	3	16	47
14	4	2	25	5	23	35	4	16	2
15	5	3	27	6	23	49	5	15	14
16	6	4	28	7	24	0	6	14	24
17	7	5	29	8	24	10	7	13	32
18	8	6	28	9	24	18	8	12	37
19	9	7	26	10	24	23	9	11	40
20	10	8	22	11	24	27	10	10	41
21	11	9	18	12	24	29	11	9	40
22	12	10	11	13	24	28	12	8	37
23	13	11	4	14	24	25	13	7	32
24	14	11	55	15	24	21	14	6	25
25	15	12	45	16	24	14	15	5	15
26	16	13	33	17	24	5	16	4	4
27	17	14	20	18	23	54	17	2	50
28	18	15	5	19	23	41	18	1	34
29	19	15	49	20	23	26	19	0	15
30	20	16	31				19	58	54
31	21	17	12				20	57	32

Leape yeare.	Aprill. ♈			May. ♉			Iune. ♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	56	7	20	59	3	20	37	23
2	22	54	41	21	56	43	21	34	31
3	23	53	13	22	54	21	22	31	38
4	24	51	42	23	51	58	23	28	46
5	25	50	10	24	49	33	24	25	52
6	26	48	35	25	47	7	25	22	58
7	27	46	58	26	44	40	26	20	4
8	28	45	19	27	42	11	27	17	10
9	29	43	37	28	39	41	28	14	15
10	♉	41	55	29	37	9	29	11	20
11	1	40	10	♊	34	36	♋	8	24
12	2	38	24	1	32	2	1	5	29
13	3	36	35	2	29	27	2	2	33
14	4	34	45	3	26	51	2	59	37
15	5	32	53	4	24	14	3	56	41
16	6	30	59	5	21	36	4	53	45
17	7	29	4	6	18	56	5	50	49
18	8	27	6	7	16	16	6	47	53
19	9	25	6	8	13	35	7	44	57
20	10	23	5	9	10	53	8	42	1
21	11	21	3	10	8	10	9	39	5
22	12	18	58	11	5	26	10	36	9
23	13	16	52	12	2	41	11	33	14
24	14	14	44	12	59	55	12	30	19
25	15	12	34	13	57	9	13	27	24
26	16	10	23	14	54	22	14	24	29
27	17	8	10	15	51	33	15	21	24
28	18	5	56	16	48	45	16	18	40
29	19	3	40	17	45	55	17	15	47
30	20	1	22	18	43	5	18	12	53
31				19	40	14			

Leape yeare.	*Iuly.* ♋			*Auguſt.* ♌			*September.* ♍		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	19	10	0	18	47	12	18	46	59
2	20	7	7	19	44	50	19	45	33
3	21	4	15	20	42	30	20	44	8
4	22	1	24	21	40	10	21	42	46
5	22	58	33	22	37	53	22	41	26
6	23	55	43	23	35	37	23	40	7
7	24	52	53	24	33	23	24	38	51
8	25	50	4	25	31	10	25	37	37
9	26	47	16	26	28	59	26	36	26
10	27	44	28	27	26	49	27	35	17
11	28	41	41	28	24	41	28	34	10
12	29	38	55	29	22	35	29	33	5
13	♌	36	10	♍	20	31	♎	32	2
14	1	33	26	1	18	28	1	31	1
15	2	30	42	2	16	27	2	30	2
16	3	28	0	3	14	28	3	29	6
17	4	25	19	4	12	31	4	28	12
18	5	22	38	5	10	35	5	27	20
19	6	19	59	6	8	42	6	26	30
20	7	17	20	7	6	50	7	25	43
21	8	14	43	8	5	0	8	24	58
22	9	12	6	9	3	12	9	24	15
23	10	9	31	10	1	26	10	23	34
24	11	6	57	10	59	42	11	22	55
25	12	4	25	11	57	59	12	22	18
26	13	1	53	12	56	18	13	21	43
27	13	59	23	13	54	40	14	21	11
28	14	56	54	14	53	0	15	20	41
29	15	54	27	15	51	29	16	20	13
30	16	52	1	16	49	57	17	19	48
31	17	49	36	17	48	27			

Leape yeare.	October. ♎			November. ♏			December. ♐		
Day.	Deg.	Mi.	Se	Deg.	Mi.	Se	Deg.	Mi.	Se.
1	18	19	25	19	24	15	19	53	44
2	19	19	3	20	24	55	20	54	58
3	20	18	44	21	25	36	21	56	13
4	21	18	26	22	26	19	22	57	29
5	22	18	11	23	27	3	23	58	45
6	23	17	58	24	27	49	25	0	2
7	24	17	47	25	28	37	26	1	19
8	25	17	38	26	29	25	27	2	37
9	26	17	32	27	30	15	28	3	55
10	27	17	28	28	31	7	29	5	13
11	28	17	26	29	32	0	♑	6	32
12	29	17	27	♐	32	55	1	7	50
13	♏	17	29	1	33	51	2	9	9
14	1	17	33	2	34	49	3	10	29
15	2	17	39	3	35	47	4	11	48
16	3	17	47	4	36	47	5	13	7
17	4	17	57	5	37	48	6	14	26
18	5	18	9	6	38	50	7	15	45
19	6	18	23	7	39	53	8	17	3
20	7	18	40	8	40	58	9	18	22
21	8	18	58	9	42	3	10	19	40
22	9	19	18	10	43	9	11	20	58
23	10	19	39	11	44	17	12	22	16
24	11	20	3	12	45	25	13	23	34
25	12	20	29	13	46	34	14	24	52
26	13	20	56	14	47	44	15	26	9
27	14	21	25	15	48	55	16	27	26
28	15	21	55	16	50	6	17	28	43
29	16	22	28	17	51	18	18	29	59
30	17	23	1	18	52	30	19	31	15
31	18	23	38				20	32	30

First yeare.	*Ianuary.* ♑			*February.* ♒			*March.* ♓		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	21	33	47	23	3	46	21	8	40
2	22	35	2	24	4	22	22	8	21
3	23	36	16	25	4	56	23	8	0
4	24	37	29	26	5	28	24	7	36
5	25	38	40	27	5	59	25	7	10
6	26	39	51	28	6	28	26	6	42
7	27	41	0	29	6	55	27	6	12
8	28	42	9	♓	7	20	28	5	39
9	29	43	16	1	7	43	29	5	4
10	♒	44	22	2	8	5	♈	4	28
11	1	45	28	3	8	25	1	3	49
12	2	46	33	4	8	43	1	3	8
13	3	47	37	5	8	59	3	2	25
14	4	48	39	6	9	13	4	1	41
15	5	49	41	7	9	25	5	0	53
16	6	50	42	8	9	35	6	0	4
17	7	51	41	9	9	43	6	59	12
18	8	52	39	10	9	50	7	58	18
19	9	53	36	11	9	54	8	57	21
20	10	54	32	12	9	56	9	56	23
21	11	55	26	13	9	56	10	55	22
22	12	56	19	14	9	54	11	54	20
23	13	57	10	15	9	49	12	53	15
24	14	58	0	16	9	43	13	52	8
25	15	58	49	17	9	35	14	51	0
26	16	59	36	18	9	24	15	49	49
27	18	0	22	19	9	12	16	48	35
28	19	1	6	20	8	57	17	47	20
29	10	1	49				18	46	0
30	21	2	30				19	44	41
31	22	3	9				20	43	19

First yeare.	Aprill.			May.			June.		
	♈			♉			♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	41	55	20	45	5	20	23	32
2	22	40	29	21	42	44	21	20	40
3	23	39	2	22	40	23	22	17	48
4	24	37	32	23	38	0	23	14	55
5	25	36	0	24	35	36	24	12	2
6	26	34	25	25	33	10	25	9	8
7	27	32	49	26	30	43	26	6	14
8	28	31	10	27	28	14	27	3	19
9	29	29	29	28	25	44	28	0	25
10	♉	27	47	29	23	13	28	57	30
11	1	26	3	♊	20	41	29	54	34
12	2	24	17	1	18	7	♋	51	39
13	3	22	29	2	15	32	1	48	43
14	4	20	40	3	12	56	2	45	47
15	5	18	48	4	10	19	3	42	51
16	6	16	55	5	7	41	4	39	55
17	7	14	59	6	5	3	5	36	59
18	8	13	2	7	2	23	6	34	3
19	9	11	3	7	59	42	7	31	7
20	10	9	2	8	57	0	8	28	11
21	11	7	0	9	54	17	9	25	15
22	12	4	56	10	51	33	10	22	20
23	13	2	50	11	48	49	11	19	24
24	14	0	42	12	46	3	12	16	29
25	14	58	33	13	43	17	13	13	34
26	15	56	22	14	40	30	14	10	39
27	16	54	10	15	37	42	15	7	34
28	17	51	56	16	34	53	16	4	50
29	18	49	40	17	32	4	17	1	56
30	19	47	23	18	29	14	17	59	3
31				19	26	23			

First yeare.	*July.* ♋	*August.* ♌	*September.* ♍
Day.	*Deg. Mi. Se.*	*Deg. Mi. Se.*	*Deg. Mi. Se.*
1	18 56 9	18 33 14	18 32 48
2	19 53 17	19 30 52	19 31 21
3	20 50 24	20 28 31	20 29 56
4	21 47 33	21 26 12	21 28 33
5	22 44 42	22 23 54	22 27 12
6	23 41 51	23 21 37	23 25 54
7	24 39 2	24 19 23	24 24 38
8	25 36 13	25 17 10	25 23 23
9	26 33 24	26 14 58	26 22 11
10	27 30 36	27 12 48	27 21 1
11	28 27 49	28 10 40	28 19 53
12	29 25 3	29 8 33	29 18 48
13	♌ 22 18	♍ 6 28	♎ 17 45
14	1 19 33	1 4 25	1 16 43
15	2 16 49	2 2 24	2 15 44
16	3 14 7	3 0 24	3 14 47
17	4 11 25	3 58 27	4 13 52
18	5 8 44	4 56 31	5 13 0
19	6 6 5	5 54 37	6 12 10
20	7 3 26	6 52 45	7 11 22
21	8 0 49	7 50 55	8 10 36
22	8 58 12	8 49 6	9 9 53
23	9 55 36	9 47 20	10 9 11
24	10 53 2	10 45 35	11 8 32
25	11 50 29	11 43 52	12 7 54
26	12 47 58	12 42 10	13 7 19
27	13 45 27	13 40 31	14 6 46
28	14 42 58	14 38 54	15 6 16
29	15 40 30	15 37 19	16 5 47
30	16 38 4	16 35 47	17 5 22
31	17 35 38	17 34 16	

First yeare.	October. ♎			November. ♏			December. ♐		
Day.	Deg.	Mi.	Se	Deg.	Mi.	Se	Deg.	Mi.	Se.
1	18	4	58	19	9	34	19	38	53
2	19	4	36	20	10	13	20	40	7
3	20	4	16	21	10	54	21	41	22
4	21	3	58	22	11	36	22	42	38
5	22	3	42	23	12	20	23	43	54
6	23	3	29	24	13	6	24	45	11
7	24	3	17	25	13	53	25	46	28
8	25	3	8	26	14	41	26	47	45
9	26	3	1	27	15	31	27	49	3
10	27	2	57	28	16	22	28	50	22
11	28	2	54	29	17	15	23	51	40
12	29	2	54	♑	18	9	♒	52	59
13	♏	2	56	1	19	5	1	54	18
14	1	2	59	2	20	2	2	55	37
15	2	3	5	3	21	1	3	56	56
16	3	3	13	4	22	0	4	58	15
17	4	3	22	5	23	1	5	59	34
18	5	3	34	6	24	3	7	0	53
19	6	3	48	7	25	6	8	2	11
20	7	4	3	8	26	10	9	3	30
21	8	4	21	9	27	15	10	4	49
22	9	4	40	10	28	21	11	6	7
23	10	5	2	11	29	28	12	7	25
24	11	5	25	12	30	36	13	8	43
25	12	5	50	13	31	45	14	10	1
26	13	6	17	14	32	55	15	11	18
27	14	6	45	15	34	5	16	12	35
28	15	7	15	16	35	16	17	13	52
29	16	7	47	17	36	28	18	15	8
30	17	8	21	18	37	40	19	16	24
31	18	8	57				20	17	39

Secod yeare.	*Ianuary.* ♑			*February.* ♒			*March.* ♓		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	21	18	56	22	49	5	20	54	12
2	22	20	11	23	49	41	21	53	53
3	23	21	25	24	50	15	22	53	32
4	24	22	38	25	50	48	23	53	9
5	25	23	50	26	51	19	24	52	44
6	26	25	1	27	51	48	25	52	16
7	27	26	51	28	52	16	26	51	46
8	28	27	19	29	52	41	27	51	15
9	29	28	27	♓	53	5	28	50	40
10	♒	29	34	1	53	27	29	50	4
11	1	30	40	2	53	48	♈	49	26
12	2	31	45	3	54	6	1	48	46
13	3	32	49	4	54	22	2	48	3
14	4	33	52	5	54	37	3	47	19
15	5	34	54	6	54	50	4	46	32
16	6	35	54	7	55	0	5	45	44
17	7	36	54	8	55	9	6	44	52
18	8	37	53	9	55	16	7	43	59
19	9	38	50	10	55	20	8	43	3
20	10	39	46	11	55	23	9	42	5
21	11	40	40	12	55	23	10	41	5
22	12	41	34	13	55	22	11	40	2
23	13	42	25	14	55	18	12	38	58
24	14	43	16	15	55	12	13	37	52
25	15	44	5	16	55	4	14	36	44
26	16	44	52	17	54	54	15	35	33
27	17	45	38	18	54	43	16	34	20
28	18	46	23	19	54	28	17	33	5
29	19	47	6				18	31	48
30	20	47	47				19	30	28
31	21	48	27				20	29	7

Secõd yeare.	April. ♈			May. ♉			June. ♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	27	43	20	31	6	20	9	41
2	22	26	18	21	28	46	21	6	49
3	23	24	50	22	26	25	22	3	57
4	24	23	21	23	24	2	23	1	4
5	25	21	50	24	21	38	23	58	11
6	26	20	16	25	19	13	24	55	18
7	27	18	40	26	16	46	25	52	24
8	28	17	2	27	14	18	26	49	29
9	29	15	21	28	11	48	27	46	35
10	♉	13	39	29	9	17	28	43	40
11	1	11	56	♊	6	45	29	40	44
12	2	10	10	1	4	12	♋	37	49
13	3	8	23	2	1	37	1	34	53
14	4	6	34	2	59	2	2	31	57
15	5	4	43	3	56	25	3	29	2
16	6	2	50	4	53	47	4	26	6
17	7	0	55	5	51	9	5	23	9
18	7	58	58	6	48	29	6	20	13
19	8	56	59	7	45	48	7	17	17
20	9	54	59	8	42	7	8	14	21
21	10	52	57	9	40	24	9	11	25
22	11	50	53	10	37	41	10	8	30
23	12	48	48	11	34	56	11	5	34
24	13	46	41	12	32	11	12	2	39
25	14	44	32	13	29	25	12	59	43
26	15	42	22	14	26	38	13	56	49
27	16	40	10	15	23	50	14	53	44
28	17	37	56	16	21	1	15	51	0
29	18	35	41	17	18	12	16	48	6
30	19	33	24	18	15	22	17	45	12
31				19	12	32			

Secõd yeare.	*July.* ♋			*August.* ♌			*September.* ♍		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	18	42	19	18	19	17	18	18	37
2	19	39	26	19	16	54	19	17	10
3	20	36	34	20	14	33	20	15	44
4	21	33	42	21	12	13	21	14	21
5	22	30	51	22	9	55	22	12	59
6	23	28	0	23	7	38	23	11	40
7	24	25	10	24	5	23	24	10	23
8	25	22	21	25	3	9	25	9	8
9	26	19	32	26	0	57	26	7	56
10	27	16	45	26	58	47	27	6	45
11	28	13	57	27	56	38	28	5	37
12	29	11	11	28	54	31	29	4	31
13	♌	8	25	29	52	26	♎	3	27
14	1	5	40	♍	50	23	1	2	25
15	2	2	57	1	48	21	2	1	26
16	3	0	14	2	46	21	3	0	28
17	3	57	32	3	44	23	3	59	33
18	4	54	51	4	42	26	4	58	40
19	5	52	11	5	40	32	5	57	49
20	6	49	32	6	38	39	6	57	1
21	7	46	54	7	36	49	7	56	15
22	8	44	17	8	35	0	8	55	31
23	9	41	42	9	33	13	9	54	49
24	10	39	7	10	31	27	10	54	9
25	11	36	34	11	29	44	11	53	31
26	12	34	2	12	28	0	12	52	55
27	13	31	31	13	26	22	13	52	21
28	14	29	2	14	24	45	14	51	50
29	15	26	33	15	23	10	15	51	22
30	16	24	7	16	21	36	16	50	55
31	17	21	41	17	20	5			

Secõd yeare.	October. ♎			November. ♏			December. ♐		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	17	50	31	18	54	52	19	24	3
2	18	50	9	19	55	31	20	25	17
3	19	49	48	20	56	11	21	26	32
4	20	49	30	21	56	53	22	27	47
5	21	49	13	22	57	37	23	29	3
6	22	48	59	23	58	22	24	30	20
7	23	48	47	24	59	3	25	31	37
8	24	48	37	25	59	57	26	32	54
9	25	48	30	27	0	46	27	34	12
10	26	48	25	28	1	37	28	35	30
11	27	48	22	29	2	30	29	36	49
12	28	48	22	♐	3	23	♑	38	7
13	29	48	23	1	4	19	1	39	26
14	♏	48	26	2	5	16	2	40	45
15	1	48	31	3	6	14	3	42	4
16	2	48	38	4	7	13	4	43	24
17	3	48	47	5	8	14	5	44	43
18	4	48	58	6	9	15	6	46	1
19	5	49	12	7	10	18	7	47	20
20	6	49	27	8	11	22	8	48	39
21	7	49	44	9	12	26	9	49	57
22	8	50	3	10	13	32	10	51	16
23	9	50	24	11	14	39	11	52	34
24	10	50	47	12	15	47	12	53	52
25	11	51	11	13	16	56	13	55	9
26	12	51	38	14	18	5	14	56	27
27	13	52	6	15	19	15	15	57	44
28	14	52	36	16	20	26	16	59	1
29	15	53	7	17	21	38	18	0	17
30	16	53	40	18	22	50	19	1	33
31	17	54	15				20	2	48

Third yeare.	January. ♑			February. ♒			March. ♓		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	4	5	22	34	23	20	39	44
2	22	5	21	23	35	0	21	39	26
3	23	6	35	24	35	35	22	39	5
4	24	7	48	25	36	8	23	38	43
5	25	9	0	26	36	39	24	38	18
6	26	10	11	27	37	9	25	37	51
7	27	11	21	28	37	37	26	37	21
8	28	12	30	29	38	3	27	36	50
9	29	13	38	♓	38	27	28	36	17
10	♒	14	45	1	38	50	29	35	41
11	1	15	51	2	39	10	♈	35	3
12	2	16	56	3	39	29	1	34	23
13	3	18	1	4	39	46	2	33	41
14	4	19	4	5	40	1	3	32	58
15	5	20	6	6	40	14	4	32	12
16	6	21	7	7	40	25	5	31	23
17	7	22	7	8	40	35	6	30	33
18	8	23	6	9	40	42	7	29	40
19	9	24	4	10	40	47	8	28	44
20	10	25	0	11	40	50	9	27	47
21	11	25	55	12	40	51	10	26	47
22	12	26	48	13	40	50	11	25	45
23	13	27	40	14	40	47	12	24	42
24	14	28	31	15	40	41	13	23	36
25	15	29	21	16	40	34	14	22	28
26	16	30	8	17	40	25	15	21	18
27	17	30	55	18	40	13	16	20	6
28	18	31	40	19	40	0	17	18	51
29	19	32	23				18	17	35
30	20	33	5				19	16	15
31	21	33	45				20	14	54

Third yeare.	Aprill. ♈			May. ♉			Iune. ♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	13	31	20	17	7	19	55	50
2	22	12	6	21	14	48	20	52	58
3	23	10	39	22	12	27	21	50	6
4	24	9	10	23	10	4	22	47	14
5	25	7	39	24	7	41	23	44	21
6	26	6	6	25	5	16	24	41	27
7	27	4	31	26	2	49	25	38	33
8	28	2	53	27	0	21	26	35	39
9	29	1	13	27	57	52	27	32	44
10	29	53	32	28	55	22	28	29	50
11	♉	57	49	29	52	50	29	26	54
12	1	56	4	♊	50	17	♋	24	0
13	2	54	17	1	47	43	1	21	3
14	3	52	28	2	45	7	2	18	8
15	4	50	37	3	42	31	3	15	12
16	5	48	45	4	39	53	4	12	16
17	6	46	50	5	37	15	5	9	20
18	7	44	54	6	34	35	6	6	24
19	8	42	56	7	31	55	7	3	28
20	9	40	56	8	28	14	8	0	32
21	10	38	54	9	26	31	8	57	36
22	11	36	51	10	23	48	9	54	40
23	12	34	46	11	21	4	10	51	44
24	13	32	39	12	18	18	11	48	49
25	14	30	31	13	15	33	12	45	53
26	15	28	21	14	12	46	13	42	58
27	16	26	9	15	9	58	14	39	54
28	17	23	56	16	7	10	15	37	9
29	18	21	41	17	4	21	16	34	15
30	19	19	25	18	1	31	17	31	22
31				18	58	41			

Third yeare.	July. ♋			August. ♌			September. ♍		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se	Deg.	Mi.	Se.
1	18	28	28	18	5	19	18	4	25
2	19	25	35	19	2	56	19	2	58
3	20	22	43	20	0	34	20	1	32
4	21	19	51	20	58	14	21	0	8
5	22	17	0	21	55	55	21	58	46
6	23	14	9	22	53	38	22	57	26
7	24	11	19	23	51	23	23	56	9
8	25	8	29	24	49	9	24	54	53
9	26	5	41	25	46	56	25	53	40
10	27	2	53	26	44	46	26	52	30
11	28	0	5	27	42	37	27	51	20
12	28	57	19	28	40	29	28	50	14
13	29	54	33	29	38	24	29	49	10
14	♌	51	48	♍	36	20	♎	48	8
15	1	49	4	1	34	18	1	47	7
16	2	46	21	2	32	17	2	46	9
17	3	43	39	3	30	19	3	45	13
18	4	40	57	4	28	22	4	44	20
19	5	38	17	5	26	27	5	43	29
20	6	35	38	6	24	34	6	42	40
21	7	33	0	7	22	43	7	41	53
22	8	30	23	8	20	53	8	41	9
23	9	27	47	9	19	6	9	40	26
24	10	25	12	10	17	20	10	39	46
25	11	22	38	11	15	36	11	39	7
26	12	20	6	12	13	54	12	38	31
27	13	17	35	13	12	14	13	37	57
28	14	15	5	14	10	36	14	37	25
29	15	12	37	15	9	0	15	36	56
30	16	10	9	16	7	26	16	36	29
31	17	7	44	17	5	55			

Third yeare.	*October.* ♎			*November.* ♏			*December.* ♐		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	17	36	4	18	40	11	19	9	13
2	18	35	41	19	40	49	20	10	26
3	19	35	21	20	41	29	21	11	41
4	20	35	2	21	42	10	22	12	56
5	21	34	45	22	42	54	23	14	12
6	22	34	30	23	43	38	24	15	29
7	23	34	17	24	44	19	25	16	45
8	24	34	7	25	45	12	26	18	3
9	25	33	59	26	46	2	27	19	20
10	26	33	54	27	46	52	28	20	39
11	27	33	50	28	47	44	29	21	57
12	28	33	49	29	48	38	♑	23	16
13	29	33	50	♐	49	33	1	24	34
14	♏	33	52	1	50	29	2	25	54
15	1	33	57	2	51	27	3	27	13
16	2	34	4	3	52	26	4	28	32
17	3	34	12	4	53	26	5	29	51
18	4	34	23	5	54	28	6	31	10
19	5	34	36	6	55	30	7	32	29
20	6	34	50	7	56	33	8	33	47
21	7	35	7	8	57	38	9	35	6
22	8	35	26	9	58	44	10	36	24
23	9	35	46	10	59	50	11	37	42
24	10	36	8	12	0	58	12	39	0
25	11	36	32	13	2	6	13	40	18
26	12	36	58	14	3	16	14	41	35
27	13	37	26	15	4	26	15	42	53
28	14	37	56	16	5	36	16	44	9
29	15	38	27	17	6	48	17	45	26
30	16	38	59	18	8	0	18	46	42
31	17	39	34				19	47	58

Fourth yeare.	*January.*			*February.*			*March.*		
	♑			♒			♓		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	20	49	14	22	19	42	21	24	58
2	21	50	30	23	20	19	22	24	38
3	22	51	45	24	20	54	23	24	16
4	23	52	58	25	21	28	24	23	52
5	24	54	11	26	21	59	25	23	25
6	25	55	22	27	22	29	26	22	56
7	26	56	32	28	22	58	27	22	26
8	27	57	41	29	23	24	28	21	53
9	28	58	49	♓	23	49	29	21	17
10	29	59	57	1	24	12	♈	20	40
11	1	♒	1 3	2	24	33	1	20	1
12	2	2	8	3	24	53	2	19	19
13	3	3	13	4	25	10	3	18	36
14	4	4	16	5	25	25	4	17	51
15	5	5	19	6	25	39	5	17	3
16	6	6	20	7	25	51	6	16	13
17	7	7	20	8	26	0	7	15	20
18	8	8	20	9	26	8	8	14	25
19	9	9	17	10	26	14	9	13	28
20	10	10	14	11	26	17	10	12	29
21	11	11	9	12	26	19	11	11	28
22	12	12	3	13	28	18	12	10	25
23	13	12	56	14	26	15	13	9	20
24	14	13	47	15	26	11	14	8	13
25	15	14	36	16	26	4	15	7	3
26	16	15	24	17	25	55	16	5	51
27	17	16	11	18	25	44	17	4	37
28	18	16	57	19	25	31	18	3	21
29	19	17	41	20	25	16	19	2	2
30	20	18	23				20	0	42
31	21	19	3				20	59	19

Fourth yeare.	*Aprill.* ♈			*May.* ♉			*Iune.* ♊		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	21	57	55	21	0	49	20	39	8
2	22	56	28	21	58	29	21	36	16
3	23	55	0	22	56	7	22	33	23
4	24	53	29	23	53	43	23	30	30
5	25	51	57	24	51	19	24	27	37
6	26	50	22	25	48	53	25	24	23
7	27	48	45	26	46	25	26	21	49
8	28	47	5	27	43	56	27	18	54
9	29	45	24	28	41	26	28	16	0
10	♉	43	41	29	38	54	29	13	4
11	1	41	57	♊	36	22	♋	10	10
12	2	40	10	1	33	48	1	7	13
13	3	38	22	2	31	12	2	4	18
14	4	36	32	3	28	36	3	1	22
15	5	34	40	4	25	59	3	58	26
16	6	32	46	5	23	21	4	55	30
17	7	30	50	6	20	42	5	52	34
18	8	28	52	7	18	1	6	49	38
19	9	26	53	8	14	20	7	46	42
20	10	24	52	9	12	38	8	43	46
21	11	22	49	10	9	55	9	40	50
22	12	20	44	11	7	11	10	37	54
23	13	18	38	12	4	26	11	34	59
24	14	16	30	13	1	40	12	32	3
25	15	14	20	13	58	54	13	29	8
26	16	12	9	14	56	6	14	26	4
27	17	9	56	15	53	18	15	23	19
28	18	7	42	16	50	29	16	20	25
29	19	5	25	17	47	40	17	17	31
30	20	3	8	18	44	50	18	14	38
31				19	41	59			

Fourth yeare.	*July.* ♋			*August.* ♌			*September.* ♍		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	19	11	45	18	48	58	18	48	46
2	20	8	52	19	46	36	19	47	20
3	21	6	0	20	44	15	20	45	56
4	22	3	9	21	41	56	21	44	33
5	23	0	18	22	39	39	22	43	13
6	23	57	28	23	37	23	23	41	55
7	24	54	38	24	35	8	24	40	39
8	25	51	49	25	32	56	25	39	25
9	26	49	1	26	30	45	26	38	14
10	27	46	13	27	28	35	27	37	5
11	28	43	26	28	26	27	28	35	58
12	29	40	40	29	24	21	29	34	53
13	♌ 0	37	55	♍ 22	17		♎ 33	50	
14	1	35	11	1	20	14	1	32	49
15	2	32	27	2	18	14	2	31	51
16	3	29	45	3	16	15	3	30	54
17	4	27	4	4	14	7	4	30	0
18	5	24	23	5	12	22	5	29	8
19	6	21	44	6	10	28	6	28	19
20	7	19	5	7	8	37	7	27	32
21	8	16	28	8	6	47	8	26	47
22	9	13	52	9	4	59	9	26	4
23	10	11	17	10	3	13	10	25	23
24	11	8	43	11	1	29	11	24	44
25	12	6	10	11	59	46	12	24	7
26	13	3	39	12	58	5	13	23	32
27	14	1	9	13	56	27	14	23	0
28	14	58	40	14	54	50	15	22	30
29	15	56	12	15	53	16	16	22	3
30	16	53	46	16	51	44	17	21	37
31	17	51	21	17	50	14			

Fourth yeare.	*October.* ♎			*November.* ♏			*December.* ♐		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	18	21	14	19	26	7	19	55	36
2	19	20	53	20	26	46	20	56	50
3	20	20	33	21	27	27	21	58	5
4	21	20	16	22	28	10	22	59	21
5	22	20	0	23	28	55	24	0	37
6	23	19	48	24	29	41	25	1	54
7	24	19	37	25	30	28	26	3	11
8	25	19	28	26	31	17	27	4	29
9	26	19	22	27	32	7	28	5	47
10	27	19	18	28	32	59	29	7	5
11	28	19	17	29	33	52	♑	8	24
12	29	19	17	♐	34	47	1	9	43
13	♏	19	19	1	35	43	2	11	2
14	1	19	23	2	36	40	3	12	21
15	2	19	29	3	37	39	4	13	40
16	3	19	37	4	38	39	5	14	59
17	4	19	47	5	39	40	6	16	18
18	5	20	0	6	40	42	7	17	37
19	6	20	14	7	41	45	8	18	56
20	7	20	30	8	42	50	9	20	14
21	8	20	48	9	43	55	10	21	33
22	9	21	8	10	45	1	11	22	51
23	10	21	30	11	46	9	12	24	9
24	11	21	54	12	47	17	13	25	27
25	12	22	19	13	48	26	14	26	44
26	13	22	47	14	49	36	15	28	1
27	14	23	16	15	50	47	16	29	18
28	15	23	46	16	51	58	17	30	35
29	16	24	19	17	53	10	18	31	51
30	17	24	53	18	54	23	19	33	7
31	18	25	29				20	34	22

CHAP.

Chap. XXVI.

The vse of these Ephemerides.

OF the vse of these Ephemerides, because they be altogether of the same forme, that others generally are, and haue bin heretofore: and to be vsed also in all points after the same manner, for finding out by them the true place of the Sun at any time desired, for so many yeares as they serue: I thinke it needlesse for me in this place to make any further mention: it being my purpose in this booke, rather to make supplie of that is wanting in others, then to meddle with that which is by them sufficiently handled and alreadie published. This notwithstanding I thought good to aduertise the reader, that these Ephemerides, though they be made for fiue yeares only, yet may profitably serue for many yeares to come after this manner: Subtract 1612 out of the yeare of Christ giuen; diuide that remaineth by foure; if any thing remaine after diuision made, it sheweth which of the three common yeres in these Ephemerides answereth to the yere giuen: if nothing remaine, the fourth yeare is answerable to the yeare giuen. Then seeke out the moneth and day of the time giuen both in these Ephemerides for that yeare, and in the table of their æquations; and out of them take both the place of the Sun, and the æquation answerable to that moneth and day: for the product of this æquation by the quotient, added to the said place of the Sun, if the number of the

the yeare giuen be more then 1612; or ſubtracted, if it be leſſe, ſhall giue you the true place of the Sunne for the time giuen.

As for example, the 1 of Iuly 1620 ſuppoſe you would know the place of the Sunne: Subtracting therfore 1612 out of 1620, the remainder is 8, which being diuided by 4, the quotient is 2, and nothing remaining; which ſheweth that the fourth yeare (*viz.* 1612) anſwereth to the yeare giuen. Alſo the ſaid moneth and day ſought out in theſe Ephemerides, and in the table of their æquations, giue you the place of the Sun 19 degr. 11 min. 45 ſec. of *Cancer*; and the æquation 1 min. 45 ſec. which multiplied by the quotient 2, make 3 min. 30 ſec. And this added to the ſaid place of the Sun the 1 of Iuly 1612, ſheweth you the true place of the Sun, for the time giuen, to be 19 deg. 15 min. and 15. ſec. of *Cancer*.

Chap. XXVII.

The making of the table of the Suns declination.

THE place of the Sunne being thus eaſily knowne by theſe Ephemerides for euerie day of fiue yeares, the declinations of the Sunne for euery day of the ſame yeares were eaſily found out of the former table of the declination of euery minute of the Ecliptick, in ſuch ſort as was ſhewed in the vſe of that table before ſet downe, chap. 18. pag. 288, and 289: And ſo was made with no leſſe facilitie the table following, of the Sunnes declination for euery day of fiue yeares together, commonly called by Sea-men, *A Regiment of the Sunne.*

Sunne. For although it hath been thought ſufficient in books of Nauigation hitherto publiſhed, to make the regiment of the Sun, or the table of the Sunnes declination for euery day of 4 yeeres, beginning with the firſt yeere after the leape yeere, and ending with the next leape yeere, becauſe the declinations of the Sun for the 4 yeeres following, haue bin ſuppoſed to be the ſame in a manner that they were the 4 yeeres before; and ſo to continue alike, without any notable difference for many yeeres: yet to bring this matter to ſome more certeintie, I haue to this table of declination prefixed the fift yeere alſo, viz. the leap yeere going before the firſt of the ſaid common yeeres; that by comparing the declinations of both leape yeeres together, it might the better appeare what difference of declination there is in euerie 4 yeeres: by addition or ſubtraction of which difference, to the declinations ſet downe in this table; this table may be made to ſerue for a great manie yeeres yet to come, as truely as if it were made of purpoſe for them.

And for the more eaſie and readier vſe of all Seamen, I haue to this end gathered into this little table, the differences of the Sunnes declinations for euery day of the firſt and laſt yeeres ſet down in this table of the Sunnes declinations here following; which differences may be called the proſthaphæreſes, or æquations of the Sunnes declination; becauſe that by adding them to, or ſubtracting them from the declinations conteined in this table, the true declination of the Sunne for any day (though many

many yeeres hence) may easily be found; and that after this manner:

Out of the number of the yeere of Christ giuen, subtract 1612; diuide the remainder by foure, and set aside the quotient; if any thing remaine, that remainder sheweth in which of the 3 common yeeres you are to seeke the Sunnes declination: if nothing remaine, you must looke the Sunnes declination in the fourth and last yeere, which is leape yeere. Then seeke the moneth and day of the time giuen, both in that yeere so found in the table of the Sunnes declination, and also in this little table of Prosthaphæreses of the Suns declination here immediatly following; taking out of that the Sunnes declination, and out of this little table the æquation of that declination for foure yeeres; which æquation you shal multiply by the said quotient, and adde the product to the declinatiõ found in the table, in the Spring and Autumne; that is, if the Sunne be in *Aries, Taurus, Gemini, Libra, Scorpio*, or *Sagittarie*; or subtract it in summer and winter, *viz.* the Sunne being in *Cancer, Leo, Virgo, Capricorne, Aquarie*, or *Pisces*; for so shall you haue the Sunnes true declination for the time giuen.

Take for example the 15 of March in the yeere of Christ 1630: out of this subtract 1612, the remainder is 18; which being diuided by 4, the quotient is also 4, and 2 remaine; which sheweth that you must seeke the Suns declination in the second yeere after the leape yeere, for the moneth and day aforesaid. Therefore I find the Suns declination in that yeere

(*viz.*

(*viz.* 1610) to be 1 deg. 54 min. 16 sec. & in this little table of Prosthaphæreses his difference of declination for 4 yeeres, 44 sec. which multiplied by the foresaid quotient 4, make 2 min. 56 sec. to be added to the said declination 1 deg. 54 min. 16 sec. that so you may haue the true declination of the Sunne for that time, *viz.* 1 deg. 57 min. 12 sec.

1610

Take also the 30 of August, in the yeere of our Lord 1659; out of which, if you subtract 1612, there shall remaine 47; which being diuided by 4, the quotient will be 11, and 3 remaining. I find therefore in the table of the Sunnes declination, in the third yeere, for the moneth & day aforesaid, the Sunnes declination 5 deg. 29 min. 35 sec. Also in this little table of Prosthaphæreses of the Sunnes declination, I find for the same moneth and day, the difference of the declination of the Sun for 4 yeeres, to be 42 sec. which multiplied by the quotient 11, make the product 7 min. 42 sec. which subtracted out of the declination aforesaid 5 deg. 29 min. 35 seconds, shall leaue you the Sunnes true declination for the 30 of August 1659, 5. degr. 21 min. 53 sec.

Prostha-

Day.	Ia. Se.	Fe. Se.	M. Se.	A. Se.	M Se.	In. Se.	In. Se.	A. Se.	Se. Se	O. Se.	N. Se.	D. Se.
1	17	36	42	40	28	8	15	33	42	41	30	9
2	18	37	43	39	28	7	15	34	43	42	29	8
3	19	37	43	40	27	6	16	35	43	42	29	7
4	20	38	44	40	27	5	17	35	43	42	28	6
5	20	37	44	39	26	4	18	34	43	41	28	5
6	21	37	43	39	25	4	19	35	43	41	28	4
7	21	38	43	38	25	3	19	35	44	41	27	3
8	22	39	43	38	24	2	19	35	43	40	26	2
9	24	38	44	38	23	2	20	36	44	40	25	1
10	24	39	45	37	23	1	21	36	43	40	24	1
11	25	39	44	37	22	0	21	37	43	40	24	0
12	25	40	44	37	22	1	22	38	43	39	23	0
13	26	41	43	37	21	1	22	38	43	39	22	1
14	26	40	44	37	20	2	23	38	44	38	21	2
15	27	41	44	35	20	3	23	38	43	38	21	3
16	28	42	43	35	19	4	24	39	44	37	20	4
17	28	41	42	35	19	4	25	39	43	38	20	5
18	29	41	43	35	18	5	26	39	43	37	19	6
19	30	41	43	34	17	6	26	39	43	37	18	7
20	31	42	42	34	17	7	27	40	43	36	17	8
21	31	42	43	33	16	8	27	40	43	36	16	9
22	32	42	43	33	15	8	28	41	44	35	16	10
23	32	43	43	32	14	9	29	40	43	35	15	11
24	32	43	42	32	14	10	29	41	42	34	14	12
25	33	44	42	31	12	11	30	41	43	34	13	12
26	33	44	41	31	12	12	30	41	42	33	13	13
27	34	43	41	30	11	13	30	41	42	34	12	14
28	35	43	41	29	11	13	31	42	42	33	11	15
29	35	43	41	29	9	14	31	41	43	32	11	16
30	35	—	41	29	9	14	32	42	42	32	10	16
31	36		41		8		33	42		31		17

Leape yeare.	*Ianuary.*				*February.*			
	Declinat.			*Differ.*	*Declinat.*			*Differ.*
Day.	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*
1	21	54	39	9 35	14	7	44	20 11
2	21	45	4	9 59	13	47	33	19 45
3	21	35	5	10 24	13	27	48	21 18
4	21	24	41	10 54	13	6	30	20 52
5	21	13	45	11 7	12	46	38	20 23
6	21	2	38	11 37	12	26	15	20 54
7	20	51	1	12 2	12	5	21	21 6
8	20	38	59	12 24	11	44	15	21 18
9	20	26	35	12 48	11	22	57	21 27
10	20	13	47	13 10	11	1	30	21 39
11	20	0	37	13 34	10	39	51	21 47
12	19	47	3	13 54	10	18	4	21 56
13	19	33	9	14 17	9	56	8	22 7
14	19	18	52	14 24	9	34	1	22 14
15	19	4	28	15 12	9	11	47	22 22
16	18	49	16	15 33	8	49	25	22 31
17	18	33	43	15 26	8	26	54	22 37
18	18	18	17	15 59	8	4	17	22 45
19	18	2	18	16 18	7	41	32	22 50
20	17	46	0	16 38	7	18	42	22 58
21	17	29	22	16 55	6	55	44	23 3
22	17	12	27	17 14	6	32	41	23 8
23	16	55	13	17 31	6	9	33	23 13
24	16	37	42	17 49	5	46	20	23 17
25	16	19	53	18 6	5	23	3	23 22
26	16	1	47	18 21	4	59	41	23 27
27	15	43	26	18 38	4	36	14	23 28
28	15	24	48	18 54	4	12	46	23 32
29	15	5	54	19 9	3	49	14	23 36
30	14	46	45	19 23				
31	14	27	22	19 38				

Leape yeare.	*March.*		*April.*	
	Declinat.	*Differ.*	*Declinat.*	*Differ.*
Day.	*Deg. Mi. Se.*	*Mi. Se.*	*Deg. Mi. Se.*	*Mi. Se.*
1	3 25 38	23 36	8 34 31	21 52
2	3 2 2	23 38	8 56 23	21 42
3	2 38 24	23 41	9 18 5	21 33
4	2 14 43	23 41	9 39 38	21 25
5	1 51 2	23 43	10 1 3	21 14
6	1 27 19	23 43	10 22 17	21 4
7	1 3 36	23 43	10 43 21	20 53
8	0 39 53	23 42	11 4 14	20 36
9	0 16 11	23 42	11 24 50	20 38
10	0 7 31	23 42	11 45 28	20 20
11	0 31 13	23 39	12 5 48	20 8
12	0 54 52	23 39	12 25 56	19 56
13	1 18 31	23 36	12 45 52	18 43
14	1 42 7	23 34	13 4 35	20 31
15	2 5 41	23 31	13 25 6	19 18
16	2 29 12	23 28	13 44 24	19 4
17	2 52 40	23 24	14 3 28	18 50
18	3 16 4	23 20	14 22 18	18 37
19	3 39 24	23 16	14 40 55	18 22
20	4 2 40	23 12	14 59 17	18 9
21	4 25 52	23 7	15 17 26	17 50
22	4 48 59	23 2	15 35 16	17 38
23	5 12 1	22 58	15 52 54	17 20
24	5 34 59	22 50	16 10 14	17 6
25	5 57 49	22 45	16 27 20	16 49
26	6 20 34	22 37	16 44 9	16 33
27	6 43 11	22 31	17 0 42	16 16
28	7 5 42	22 24	17 16 58	15 58
29	7 28 6	22 16	17 32 56	15 41
30	7 50 22	22 8	17 48 37	15 24
31	8 12 30	22 1		

Leape yeare.	May.				June.			
	Declinat.		Differ.		Declinat.		Differ.	
Day.	Deg.	Mi. Se.	Mi.	Se.	Deg.	Mi. Se.	Mi.	Se.
1	18	4 1	15	5	23	11 32	3	50
2	18	19 6	14	48	23	15 22	3	26
3	18	33 54	14	28	23	18 48	3	1
4	18	48 22	14	10	23	21 49	2	38
5	19	2 32	13	51	23	24 27	1	12
6	19	16 23	13	21	23	25 39	2	47
7	19	29 54	13	12	23	28 26	1	23
8	19	43 6	12	52	23	29 49	0	58
9	19	55 58	12	35	23	30 47	0	34
10	20	8 33	12	8	23	31 21	0	9
11	20	20 41	11	49	23	31 30	0	16
12	20	32 30	11	30	23	31 14	0	42
13	20	44 0	11	9	23	30 32	1	5
14	20	55 9	10	8	23	29 27	1	29
15	21	6 7	10	14	23	27 58	1	56
16	21	16 21	10	3	23	26 2	2	19
17	21	26 24	10	42	23	23 43	2	44
18	21	36 6	9	19	23	20 59	3	2
19	21	45 25	8	57	23	17 57	3	39
20	21	54 22	8	34	23	14 18	3	57
21	22	2 56	8	12	23	10 21	3	22
22	22	11 8	7	48	23	4 59	3	45
23	22	18 56	7	25	23	1 14	5	10
24	22	26 21	7	3	22	56 4	5	33
25	22	33 24	6	48	22	50 31	5	57
26	22	40 2	6	15	22	44 34	6	19
27	22	46 17	5	50	22	38 15	6	45
28	22	52 7	5	28	22	31 30	7	8
29	22	57 35	5	3	22	24 22	7	3
30	23	2 38	4	39	22	16 51	7	53
31	23	7 17	4	15				

Leape yeare.	July.				August.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	22	8	58	8 16	15	14	50	18 3
2	22	0	42	8 39	14	56	47	18 17
3	21	52	3	9 2	14	38	30	18 32
4	21	43	1	9 23	14	19	58	18 47
5	21	33	38	9 45	14	1	11	18 58
6	21	23	53	10 8	13	42	13	19 13
7	21	13	45	10 29	13	23	0	19 24
8	21	3	16	10 50	13	3	36	19 38
9	20	52	26	11 10	12	43	58	19 50
10	20	41	16	11 33	12	24	8	20 1
11	20	29	43	11 53	12	4	7	20 13
12	20	17	50	12 13	11	43	54	20 25
13	20	5	37	12 34	11	23	29	20 36
14	19	53	3	12 53	11	2	53	20 46
15	19	40	10	13 12	10	42	7	20 56
16	19	26	58	13 33	10	21	11	21 6
17	19	13	25	13 51	10	0	5	21 17
18	18	59	34	14 10	9	38	48	21 25
19	18	45	24	14 28	9	17	23	21 34
20	18	30	56	14 47	8	55	49	21 44
21	18	16	9	15 6	8	34	5	21 51
22	18	1	3	15 22	8	12	14	22 0
23	17	45	41	15 40	7	50	14	22 7
24	17	30	1	15 57	7	28	7	22 15
25	17	14	4	16 14	7	5	52	22 21
26	16	57	50	16 31	6	43	31	22 28
27	16	41	19	16 46	6	21	3	22 33
28	16	24	33	17 3	5	58	30	22 43
29	16	7	30	17 18	5	35	47	22 46
30	15	50	12	17 33	5	13	1	22 52
31	15	32	39	17 49	4	50	9	22 58

Leape yeare.	September.						October.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mt.	Se.	Mt.	Se.		Deg.	Mt.	Se.	Mt.	Se.	
1	4	27	11	23	1		7	12	32	22	43	
2	4	4	10	23	6		7	35	15	22	37	
3	3	41	4	23	10		7	57	52	22	30	
4	3	17	54	23	14		8	20	22	22	23	
5	2	54	40	23	18		8	42	45	22	16	
6	2	31	22	23	20		9	5	1	22	8	
7	2	8	2	23	23		9	27	9	22	0	
8	1	44	39	23	26		9	49	9	21	52	
9	1	21	13	23	28		10	11	1	21	42	
10	0	57	45	23	30		10	32	43	21	33	
11	0	34	15	23	30		10	54	16	21	24	
12	0	10	45	23	32		11	15	40	21	13	
13	0	12	47	23	32		11	36	53	21	3	
14	0	36	19	23	33		11	57	56	20	51	
15	0	59	52	23	33		12	18	47	20	40	
16	1	23	25	23	33		12	39	27	20	27	
17	1	46	58	23	31		12	59	54	20	17	
18	2	10	29	23	31		13	20	11	20	3	
19	2	34	0	23	29		13	40	14	19	50	
20	2	57	29	23	28		14	0	4	19	37	
21	3	20	57	23	25		14	19	41	19	23	
22	3	44	22	23	23		14	39	4	19	7	
23	4	7	45	23	20		14	58	11	18	55	
24	4	31	5	23	16		15	17	6	18	38	
25	4	54	21	23	13		15	35	44	18	23	
26	5	17	34	23	9		15	54	7	18	6	
27	5	40	43	23	5		16	12	13	17	51	
28	6	3	48	22	59		16	30	4	17	34	
29	6	26	47	22	55		16	47	38	17	16	
30	6	49	42	22	50		17	4	54	16	59	
31							17	21	53	16	41	

Leape yeare.	*Nouember.*				*December.*			
	Declinat.		*Differ.*		*Declinat.*		*Differ.*	
Day.	*Deg.*	*Mi*	*Se.*	*Mi. Se.*	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*
1	17	38	34	16 23	23	8	20	4 25
2	17	54	57	16 3	23	12	45	3 58
3	18	11	0	15 55	23	16	43	3 30
4	18	26	55	15 14	23	20	13	3 2
5	18	42	9	15 5	23	23	15	2 33
6	18	57	14	14 44	23	25	48	2 6
7	19	11	58	14 23	23	27	54	1 36
8	19	26	21	14 3	23	29	30	1 9
9	19	40	24	13 41	23	30	39	0 39
10	19	54	5	13 18	23	31	18	0 12
11	20	7	23	12 56	23	31	30	0 18
12	20	20	19	12 24	23	31	12	0 46
13	20	32	43	12 21	23	30	26	1 14
14	20	45	4	11 47	23	29	12	1 43
15	20	56	51	11 24	23	27	29	2 11
16	21	8	15	10 59	23	25	18	2 40
17	21	19	14	10 35	23	22	38	3 8
18	21	29	49	10 12	23	19	30	3 36
19	21	40	1	9 44	23	15	54	4 4
20	21	49	45	9 21	23	11	50	4 32
21	21	59	6	8 53	23	7	18	5 1
22	22	7	59	8 29	23	2	17	5 28
23	22	16	28	8 3	22	56	49	5 54
24	22	24	31	7 29	22	50	55	6 23
25	22	32	0	7 17	22	44	32	6 50
26	22	39	17	6 48	22	37	42	7 17
27	22	46	0	6 16	22	30	25	7 43
28	22	52	16	5 48	22	22	42	8 10
29	22	58	4	5 21	22	14	32	8 36
30	23	3	25	4 55	22	5	56	9 2
31					21	56	54	9 27

First yeare.	January.				February.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	21	47	27	9 54	13	52	43	20 2
2	21	37	33	10 19	13	32	41	20 15
3	21	27	14	10 43	13	12	26	20 28
4	21	16	31	11 7	12	51	58	20 40
5	21	5	24	11 33	12	31	18	20 52
6	20	53	51	11 55	12	10	26	21 3
7	20	41	56	12 19	11	49	23	21 15
8	20	29	37	12 41	11	28	8	21 26
9	20	16	56	13 6	11	6	42	21 35
10	20	3	50	13 27	10	45	7	21 45
11	19	50	23	13 49	10	23	22	21 55
12	19	36	34	14 13	10	1	27	22 4
13	19	22	21	14 31	9	39	23	22 12
14	19	7	50	14 54	9	17	11	22 20
15	18	52	56	15 15	8	54	51	22 29
16	18	37	41	15 35	8	32	22	22 35
17	18	22	6	15 53	8	9	47	22 43
18	18	6	13	16 15	7	47	4	22 50
19	17	49	58	16 31	7	24	14	22 55
20	17	33	27	16 52	7	1	19	23 25
21	17	16	35	17 9	6	37	54	22 44
22	16	59	26	17 28	6	15	10	23 12
23	16	41	58	17 44	5	51	58	23 16
24	16	24	14	18 2	5	28	42	23 21
25	16	6	12	18 18	5	5	21	23 25
26	15	47	54	18 34	4	41	56	23 29
27	15	29	20	18 50	4	18	27	23 31
28	15	10	30	19 5	3	54	56	23 34
29	14	51	25	19 19				
30	14	32	6	19 35				
31	14	12	31	19 48				

First yeare.	March.		April.	
	Declinat.	Differ.	Declinat.	Differ.
Day.	Deg. Mi. Se.	Mi. Se.	Deg. Mi. Se.	Mi. Se.
1	3 31 22	23 36	8 29 11	21 54
2	3 7 46	23 39	8 51 5	21 46
3	2 44 7	23 40	9 12 51	21 35
4	2 20 27	23 41	9 34 26	21 27
5	1 56 46	23 43	9 55 53	21 16
6	1 33 3	23 42	10 17 9	21 7
7	1 9 21	23 43	10 38 16	20 56
8	0 45 38	23 43	10 59 12	20 44
9	0 21 55	23 42	11 19 56	20 34
10	0 1 47	23 42	11 40 30	20 23
11	0 25 29	23 39	12 0 53	20 11
12	0 49 8	23 39	12 21 4	19 59
13	1 12 47	23 37	12 41 3	19 47
14	1 36 24	23 34	13 0 50	19 34
15	1 59 58	23 32	13 20 24	19 20
16	2 23 30	23 29	13 39 44	19 8
17	2 46 59	23 25	13 58 52	18 54
18	3 10 24	23 21	14 17 46	18 39
19	3 33 45	23 17	14 36 25	18 26
20	3 57 2	23 14	14 54 51	18 11
21	4 20 16	23 8	15 13 2	17 51
22	4 43 24	23 3	15 30 53	17 47
23	5 6 27	22 58	15 48 38	17 26
24	5 29 25	22 52	16 6 4	17 9
25	5 52 17	22 47	16 23 13	16 53
26	6 15 4	22 38	16 40 6	16 37
27	6 37 42	22 34	16 56 43	16 20
28	7 0 16	22 24	17 13 3	16 2
29	7 22 40	22 19	17 29 5	15 46
30	7 44 59	22 10	17 44 51	15 32
31	8 7 9	22 2		

First yeare.	May.				June.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se	Mi. Se	Deg.	Mi.	Se.	Mi. Se
1	18	0	23	15 6	23	10	32	3 57
2	18	15	29	14 52	23	14	29	3 31
3	18	30	21	14 33	23	18	0	3 8
4	18	44	54	14 16	23	21	8	2 43
5	18	59	10	13 53	23	23	51	2 18
6	19	13	3	13 37	23	25	9	2 53
7	19	26	40	13 16	23	28	2	1 29
8	19	39	56	12 57	23	29	31	1 4
9	19	52	53	12 36	23	30	35	0 40
10	20	5	29	12 16	23	31	15	0 15
11	20	17	45	11 55	23	31	30	0 10
12	20	29	40	11 35	23	31	20	0 35
13	20	41	15	11 13	23	30	45	1 0
14	20	52	28	10 52	23	29	45	1 24
15	21	3	20	10 32	23	28	21	2 49
16	21	13	52	10 9	23	25	32	1 13
17	21	24	1	9 47	23	24	19	2 38
18	21	33	48	9 24	23	21	41	3 2
19	21	43	12	9 2	23	18	39	3 28
20	21	52	14	8 41	23	15	11	3 50
21	22	0	55	8 16	23	11	21	4 12
22	22	9	11	7 55	23	7	9	5 44
23	22	17	6	7 30	23	2	25	5 3
24	22	24	36	7 7	22	57	22	5 28
25	22	31	43	6 45	22	51	54	5 53
26	22	38	28	6 20	22	46	3	6 14
27	22	44	48	5 57	22	39	49	6 40
28	22	50	45	5 32	22	33	9	7 1
29	22	56	17	5 9	22	26	8	7 25
30	23	1	26	4 46	22	18	43	7 48
31	23	6	12	4 20				

First yeare.	July.			August.		
	Declinat.		Differ.	Declinat.		Differ.
Day.	Deg.	Mi. Se.	Mi. Se.	Deg	Mi. Se.	Mi. Se.
1	22	10 55	8 11	15	19 11	18 1
2	22	2 44	8 34	15	1 10	18 14
3	21	54 10	8 56	14	42 56	18 28
4	21	45 14	9 17	14	24 28	18 42
5	21	35 57	9 40	14	5 46	18 56
6	21	26 17	10 2	13	46 50	19 9
7	21	16 15	10 24	13	27 41	20 22
8	21	5 51	10 45	13	7 19	18 34
9	20	55 6	11 6	12	48 45	19 48
10	20	44 0	11 29	12	28 57	19 58
11	20	32 31	11 47	12	8 59	20 11
12	20	20 44	12 6	11	48 48	20 22
13	20	8 38	12 30	11	28 26	20 32
14	19	56 8	12 48	11	7 54	20 43
15	19	43 20	13 9	10	47 11	20 55
16	19	30 11	13 27	10	26 16	21 4
17	19	16 44	13 47	10	5 12	21 13
18	19	2 57	14 5	9	43 59	21 23
19	18	48 52	14 24	9	22 36	21 33
20	18	34 28	14 42	9	1 3	21 41
21	18	19 46	15 1	8	39 22	21 49
22	18	4 45	15 19	8	17 33	21 59
23	17	49 26	15 36	7	55 34	22 4
24	17	33 50	15 52	7	33 30	22 14
25	17	17 58	16 19	7	11 16	22 19
26	17	1 48	16 36	6	48 57	22 17
27	16	45 21	16 52	6	26 30	22 33
28	16	28 38	16 58	6	3 57	22 39
29	16	11 40	17 15	5	41 18	22 46
30	15	54 25	17 29	5	18 32	22 50
31	15	36 56	17 45	4	55 42	22 56

First yeare.	September.			October.		
	Declinat.		Differ.	Declinat.		Differ.
Day.	Deg.	Mi. Se.	Mi. Se.	Deg.	Mi. Se.	Mi. Se.
1	4	32 46	23 1	7	7 0	22 45
2	4	9 45	23 5	7	29 45	22 39
3	3	46 40	23 9	7	52 24	22 31
4	3	23 31	23 14	8	14 55	22 25
5	3	0 17	23 16	8	37 20	22 19
6	2	37 1	23 20	8	59 39	22 9
7	2	13 41	23 22	9	21 48	22 2
8	1	50 19	23 25	9	43 51	21 53
9	1	26 54	23 27	10	5 44	21 45
10	1	3 27	23 29	10	27 29	21 35
11	0	39 58	23 31	10	49 4	21 26
12	0	16 27	23 32	11	10 30	21 16
13	0	7 5	23 32	11	31 46	21 5
14	0	30 37	23 33	11	52 51	20 54
15	0	54 10	23 33	12	13 45	20 43
16	1	17 43	23 31	12	34 28	20 30
17	1	41 14	23 33	12	54 58	20 19
18	2	4 47	23 31	13	15 17	20 7
19	2	28 18	23 30	13	35 24	19 53
20	2	51 48	23 28	13	55 17	19 40
21	3	15 16	23 26	14	14 57	19 26
22	3	38 42	23 23	14	34 23	19 12
23	4	2 5	23 21	14	53 35	18 57
24	4	25 26	23 17	15	12 32	18 42
25	4	48 43	23 14	15	31 14	18 27
26	5	11 57	23 10	15	49 41	18 10
27	5	35 7	23 5	16	7 51	17 55
28	5	58 12	23 1	16	25 46	17 38
29	6	21 13	23 56	16	43 24	17 21
30	6	44 9	22 1	17	0 45	17 3
31				17	17 48	16 45

First yeare.	Nouember.				December.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	17	34	33	16 28	23	7	10	4 33
2	17	51	1	16 7	23	11	43	4 5
3	18	7	8	15 50	23	15	48	3 37
4	18	22	58	15 29	23	19	25	3 9
5	18	38	27	15 10	23	22	34	2 40
6	18	53	37	14 48	23	25	14	2 12
7	19	8	25	14 29	23	27	26	1 44
8	19	22	54	14 7	23	29	10	1 14
9	19	37	1	13 46	23	30	24	0 48
10	19	50	47	13 24	23	31	12	0 18
11	20	4	11	13 2	23	31	30	0 11
12	20	17	13	12 39	23	31	19	0 39
13	20	29	52	12 16	23	30	40	1 7
14	20	42	8	11 53	23	29	33	1 36
15	20	54	1	11 30	23	27	57	2 4
16	21	5	31	11 5	23	25	53	2 34
17	21	16	36	10 42	23	23	19	3 1
18	21	27	18	10 16	23	20	18	3 29
19	21	37	34	9 52	23	16	49	3 57
20	21	47	26	9 25	23	12	52	4 26
21	21	56	51	9 1	23	8	26	4 54
22	22	5	52	8 36	23	3	32	5 20
23	22	14	28	8 8	22	58	12	5 49
24	22	22	36	7 43	22	52	23	6 16
25	22	30	19	7 16	22	46	7	6 43
26	22	37	35	6 50	22	39	24	7 10
27	22	44	25	6 23	22	32	14	7 37
28	22	50	48	5 54	22	24	37	8 4
29	22	56	42	5 26	22	16	33	8 29
30	23	2	8	5 2	22	8	4	8 56
31					21	59	8	9 22

Secõd yeare.	*Ianuary.*				*February.*			
	Declinat.		*Differ.*		*Declinat.*		*Differ.*	
Day.	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*
1	21	49	46	9 48	13	57	32	19 59
2	21	39	58	10 11	13	37	33	20 11
3	21	29	47	10 38	13	17	22	20 25
4	21	19	9	11 1	12	56	57	20 37
5	21	8	8	11 26	12	36	20	20 49
6	20	56	42	11 50	12	15	31	21 1
7	20	44	52	12 14	11	54	30	21 11
8	20	32	38	12 36	11	33	19	21 24
9	20	20	2	12 59	11	11	55	21 32
10	20	7	3	13 23	10	50	23	21 54
11	19	53	40	13 44	10	28	29	21 42
12	19	39	56	14 6	10	6	47	22 1
13	19	25	50	14 29	9	44	46	22 11
14	19	11	21	14 47	9	22	35	22 19
15	18	56	34	15 9	9	0	16	22 26
16	18	41	25	15 29	8	37	50	22 35
17	18	25	56	15 51	8	15	15	22 41
18	18	10	5	16 8	7	52	34	22 48
19	17	53	57	16 29	7	29	46	22 54
20	17	37	28	16 46	7	6	52	23 0
21	17	20	42	17 6	6	43	52	23 5
22	17	3	36	17 22	6	20	47	23 11
23	16	46	14	17 41	5	57	36	23 16
24	16	28	33	17 58	5	34	20	23 20
25	16	10	35	18 13	5	11	0	23 4
26	15	52	22	18 31	4	47	56	23 47
27	15	33	51	18 45	4	24	9	23 30
28	15	15	6	19 2	4	0	39	23 34
29	14	56	4	19 16				
30	14	36	48	19 31				
31	14	17	17	19 45				

Secõd yeare.	March.		April.	
	Declinat.	Differ.	Declinat.	Differ.
Day.	Deg. Mi. Se.	Mi. Se.	Deg. Mi. Se.	Mi. Se.
1	3 37 5	23 36	8 23 52	21 56
2	3 13 29	23 38	8 45 48	21 46
3	2 49 51	23 40	9 7 34	21 39
4	2 26 11	23 41	9 29 13	21 28
5	2 2 30	23 41	9 50 41	21 20
6	1 38 49	23 43	10 12 1	21 9
7	1 15 6	23 43	10 33 10	20 58
8	0 51 23	23 53	10 54 8	20 47
9	0 27 30	23 32	11 14 55	20 37
10	0 3 58	23 41	11 35 32	20 26
11	0 19 43	23 41	11 55 58	20 14
12	0 43 24	23 39	12 16 12	20 2
13	1 7 3	23 38	12 36 14	19 49
14	1 30 41	23 35	12 56 3	19 38
15	1 54 16	23 32	13 15 41	19 24
16	2 17 48	23 29	13 35 5	19 10
17	2 41 17	23 27	13 54 15	18 57
18	3 4 44	23 22	14 13 12	18 43
19	3 28 6	23 18	14 31 55	18 30
20	3 51 24	23 26	14 50 25	18 14
21	4 14 50	23 58	15 8 39	17 59
22	4 37 48	23 4	15 26 38	17 44
23	5 0 52	23 0	15 44 22	17 29
24	5 23 52	22 53	16 1 51	17 14
25	5 46 45	22 48	16 19 5	16 57
26	6 9 33	22 41	16 36 2	16 41
27	6 32 14	22 34	16 52 43	16 24
28	6 54 48	22 27	17 9 7	16 7
29	7 17 15	22 20	17 25 14	16 49
30	7 39 35	22 13	17 41 3	15 33
31	8 1 48	22 44		

Secõd yeare.	May.				June.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se
1	17	56	36	15 14	23	9	31	4 2
2	18	11	50	15 6	23	13	33	3 38
3	18	26	56	14 30	23	17	11	3 13
4	18	41	26	14 17	23	20	24	2 50
5	18	55	43	14 0	23	23	14	2 24
6	19	9	43	13 41	23	25	38	1 59
7	19	23	24	13 21	23	27	37	1 35
8	19	36	45	13 1	23	29	12	1 10
9	19	49	46	12 41	23	30	22	0 46
10	20	2	27	12 22	23	31	8	0 21
11	20	14	49	12 1	23	31	29	0 4
12	20	26	50	11 38	23	31	25	0 29
13	20	38	28	11 19	23	30	56	0 54
14	20	49	47	10 57	23	30	2	1 18
15	21	0	44	10 37	23	28	44	1 43
16	21	11	21	10 14	23	27	1	2 7
17	21	21	35	10 2	23	24	54	2 33
18	21	31	37	9 20	23	22	21	2 56
19	21	40	57	8 59	23	19	25	3 21
20	21	49	56	8 55	23	16	4	3 46
21	21	58	51	8 22	23	12	18	4 9
22	22	7	13	8 0	23	8	9	4 34
23	22	15	13	7 35	23	3	35	4 57
24	22	22	48	7 14	22	58	38	5 22
25	22	30	2	6 49	22	53	16	5 45
26	22	36	51	6 27	22	47	31	6 9
27	22	43	18	6 2	22	41	22	6 34
28	22	49	20	5 39	22	34	48	6 56
29	22	54	59	5 15	22	27	52	7 20
30	23	0	14	4 51	22	20	32	7 42
31	23	5	5	4 26				

Secõd yeare.	*July.*						*August.*					
	Declinat.			*Differ.*			*Declinat.*			*Differ.*		
Day.	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*		*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*	
1	22	12	50	8	5		15	23	30	17	56	
2	22	4	45	8	28		15	5	34	18	12	
3	21	56	17	8	51		14	47	22	18	24	
4	21	47	26	9	13		14	28	58	18	39	
5	21	38	13	9	34		14	10	19	18	53	
6	21	28	39	9	57		13	51	26	19	6	
7	21	18	42	10	18		13	32	20	19	18	
8	21	8	24	10	40		13	13	2	19	32	
9	20	57	44	11	1		12	53	30	19	44	
10	20	46	43	11	22		12	33	46	20	16	
11	20	35	21	10	52		12	13	30	19	49	
12	20	24	29	12	54		11	53	41	20	17	
13	20	11	35	12	24		11	33	24	20	31	
14	19	59	11	12	44		11	12	53	20	40	
15	19	46	27	13	7		10	52	13	20	52	
16	19	33	20	13	18		10	31	21	21	2	
17	19	20	2	13	43		10	10	19	21	11	
18	19	6	19	14	1		9	49	8	21	21	
19	18	52	18	14	19		9	27	47	21	30	
20	18	37	59	14	38		9	6	17	21	39	
21	18	23	21	14	57		8	44	38	21	48	
22	18	8	24	15	13		8	22	50	21	56	
23	17	53	11	15	32		8	0	54	22	2	
24	17	37	39	15	49		7	38	52	22	12	
25	17	21	50	16	6		7	16	40	22	17	
26	17	5	44	16	22		6	54	23	22	26	
27	16	49	22	16	40		6	31	57	22	31	
28	16	32	42	16	54		6	9	26	22	39	
29	16	15	48	17	11		5	46	47	22	43	
30	15	58	37	17	26		5	24	4	22	50	
31	15	41	11	17	41		5	1	14	22	55	

Secōd yeare.	September.			October.		
	Declinat.		Differ.	Declinat.		Differ.
Day.	Deg.	Mi. Se.	Mi. Se.	Deg.	Mi. Se.	Mi. Se.
1	4	38 19	22 59	7	1 29	22 47
2	4	15 20	23 4	7	24 16	22 39
3	3	52 16	23 8	7	46 55	22 34
4	3	29 8	23 12	8	9 29	22 26
5	3	5 56	23 16	8	31 55	22 20
6	2	42 40	23 19	8	54 15	22 12
7	2	19 21	23 22	9	16 27	22 3
8	1	55 59	23 24	9	38 30	21 57
9	1	32 35	23 27	10	0 27	21 46
10	1	9 8	23 29	10	22 13	21 38
11	0	45 39	23 30	10	43 51	21 28
12	0	22 9	23 32	11	5 19	21 18
13	0	1 23	23 32	11	26 37	21 8
14	0	24 55	23 32	11	47 45	20 57
15	0	48 27	23 33	12	8 42	20 45
16	1	12 0	23 33	12	29 27	20 34
17	1	35 33	23 32	12	50 1	20 21
18	1	59 5	23 32	13	9 22	20 10
19	2	22 37	23 29	13	30 32	19 57
20	2	46 6	23 29	13	50 29	19 43
21	3	9 35	23 26	14	10 12	19 30
22	3	33 1	23 25	14	29 42	19 15
23	3	56 26	23 21	14	48 57	19 1
24	4	19 47	23 18	15	7 58	18 56
25	4	43 5	23 14	15	26 44	18 30
26	5	6 19	23 11	15	45 14	18 15
27	5	29 30	23 7	16	3 29	17 59
28	5	52 37	23 3	16	21 28	17 41
29	6	15 40	22 56	16	39 9	17 25
30	6	38 36	22 53	16	56 34	17 7
31				17	13 41	16 50

Secõd yeare.	November.				December.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	17	30	31	16 32	23	5	0	5 40
2	17	47	3	16 13	23	10	40	4 11
3	18	3	16	15 53	23	14	51	3 44
4	18	19	9	15 34	23	18	35	3 15
5	18	34	43	15 15	23	21	50	2 48
6	18	49	58	14 55	23	24	38	2 18
7	19	4	53	14 32	23	26	56	1 51
8	19	19	25	14 13	23	28	47	1 22
9	19	33	38	13 51	23	30	9	0 54
10	19	47	29	13 30	23	31	3	0 25
11	20	0	59	13 7	23	31	28	0 4
12	20	14	6	12 45	23	31	24	0 32
13	20	26	51	12 21	23	30	52	1 1
14	20	39	12	12 10	23	29	51	1 28
15	20	51	22	11 24	23	28	23	2 58
16	21	2	46	11 12	23	25	25	1 23
17	21	13	58	10 46	23	24	2	2 7
18	21	24	44	10 23	23	21	5	3 23
19	21	35	7	9 57	23	17	42	3 50
20	21	45	4	9 33	23	13	52	4 19
21	21	54	37	9 7	23	9	33	4 47
22	22	3	44	8 41	23	4	46	5 14
23	22	12	25	8 15	22	59	32	5 42
24	22	20	40	7 50	22	53	50	6 10
25	22	28	30	7 23	22	47	40	6 36
26	22	35	53	6 55	22	41	4	7 4
27	22	42	48	6 29	22	34	0	7 30
28	22	49	17	6 2	22	26	30	7 57
29	22	55	19	5 34	22	18	33	8 23
30	23	0	53	4 7	22	10	10	8 50
31					22	1	20	9 16

Third yeare.	January.						February.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi	Se.		Deg.	Mi.	Se.	Mi	Se.	
1	21	52	4	9	41		14	2	20	19	55	
2	21	42	23	10	6		13	42	25	20	9	
3	21	32	17	10	31		13	22	16	20	21	
4	21	21	46	10	56		13	1	55	20	35	
5	21	10	50	11	20		12	41	20	20	45	
6	20	59	30	11	44		12	20	35	20	58	
7	20	47	46	12	8		11	59	37	21	10	
8	20	35	38	12	31		11	38	27	21	27	
9	20	23	7	12	54		11	17	0	21	23	
10	20	10	13	13	16		10	55	37	21	41	
11	19	56	57	13	39		10	33	56	21	50	
12	19	43	18	14	1		10	12	6	22	0	
13	19	29	17	14	22		9	50	6	22	7	
14	19	14	55	14	44		9	27	59	22	17	
15	19	0	11	15	4		9	5	42	22	25	
16	18	45	7	15	25		8	43	17	22	32	
17	18	29	42	15	45		8	20	45	22	40	
18	18	13	57	16	4		7	58	5	22	46	
19	17	57	53	16	24		7	35	19	22	53	
20	17	41	29	16	42		7	12	26	22	59	
21	17	24	47	17	1		6	49	27	23	4	
22	17	7	46	17	17		6	26	23	23	10	
23	16	50	29	17	37		6	3	13	23	14	
24	16	32	52	17	53		5	39	59	23	19	
25	16	14	59	18	10		5	16	40	23	23	
26	15	56	49	18	27		4	53	17	23	26	
27	15	38	22	18	42		4	29	51	23	30	
28	15	19	40	18	58		4	6	21	23	33	
29	15	0	42	19	13							
30	14	41	29	19	27							
31	14	22	2	19	42							

Third yeare.	March.						April.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	3	42	48	23	35		8	18	31	21	58	
2	3	19	13	23	38		8	40	29	21	49	
3	2	55	35	23	39		9	2	18	21	41	
4	2	31	56	23	41		9	23	59	21	31	
5	2	8	15	23	42		9	45	30	21	21	
6	1	44	33	23	42		10	6	51	21	12	
7	1	20	51	23	43		10	28	3	21	1	
8	0	57	8	23	43		10	49	4	20	50	
9	0	33	25	23	42		11	9	54	20	40	
10	0	9	43	23	42		11	30	34	20	28	
11	0	13	59	23	41		11	51	2	20	16	
12	0	37	40	23	39		12	11	18	20	6	
13	1	1	19	23	38		12	31	24	19	52	
14	1	24	57	23	36		12	51	16	19	40	
15	1	48	33	23	33		13	9	56	19	27	
16	2	12	6	23	30		13	30	23	19	15	
17	2	35	36	23	27		13	49	38	19	0	
18	2	59	3	23	24		14	8	38	18	47	
19	3	22	27	23	19		14	27	25	18	32	
20	3	45	46	23	15		14	45	57	18	18	
21	4	9	1	23	10		15	4	15	18	3	
22	4	32	11	23	6		15	22	18	17	48	
23	4	55	17	23	1		15	40	6	17	33	
24	5	18	18	22	55		15	57	39	17	17	
25	5	41	13	22	49		16	14	56	17	1	
26	6	4	2	22	42		16	31	57	16	45	
27	6	26	44	22	37		16	48	42	16	28	
28	6	49	21	22	28		17	5	10	16	11	
29	7	11	49	22	22		17	21	21	15	54	
30	7	34	11	22	14		17	37	15	15	36	
31	7	56	25	22	6							

Third yeare.	*May.*				*June.*			
	Declinat.			*Differ.*	*Declinat.*			*Differ.*
Day.	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*	*Deg.*	*Mi.*	*Se*	*Mi. Se*
1	17	52	51	15 19	23	8	29	4 8
2	18	8	10	15 1	23	12	37	3 43
3	18	23	11	14 42	23	16	20	3 20
4	18	37	53	14 23	23	19	40	2 55
5	18	52	16	14 5	23	22	35	2 30
6	19	6	21	13 45	23	25	5	2 5
7	19	20	6	13 26	23	27	10	1 41
8	19	33	32	13 6	23	28	51	1 16
9	19	46	38	12 47	23	30	7	0 52
10	19	59	25	12 26	23	30	59	0 27
11	20	11	51	12 5	23	31	26	0 2
12	20	23	56	11 45	23	31	28	0 23
13	20	35	41	11 23	23	31	5	0 48
14	20	47	4	11 4	23	30	17	1 11
15	20	58	8	10 41	23	29	6	1 40
16	21	8	49	10 19	23	27	26	1 59
17	21	19	8	9 58	23	25	27	2 26
18	21	29	6	9 35	23	23	1	2 51
19	21	38	41	9 4	23	20	10	3 15
20	21	47	45	9 0	23	16	55	3 39
21	21	56	45	8 28	23	13	16	4 4
22	22	5	13	8 6	23	9	12	4 29
23	22	13	19	7 41	23	4	43	4 51
24	22	21	0	7 19	22	59	52	5 16
25	22	18	19	6 55	22	54	36	5 40
26	22	35	14	6 33	22	48	56	6 2
27	22	41	47	6 8	22	42	54	6 28
28	22	47	55	5 44	22	36	26	6 51
29	22	53	39	5 21	22	29	35	7 14
30	22	59	0	4 56	22	22	21	7 37
31	23	3	56	4 33				

Third yeare	July.				August.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	22	14	44	7 59	15	27	48	17 52
2	22	6	45	8 22	15	9	56	18 7
3	21	58	23	8 46	14	51	49	18 22
4	21	49	37	9 7	14	33	27	18 35
5	21	40	30	9 30	14	14	52	18 50
6	21	31	0	9 51	13	56	2	19 3
7	21	21	9	10 13	13	36	59	19 15
8	21	10	56	10 35	13	17	44	19 29
9	21	0	21	10 56	12	58	15	19 40
10	20	49	25	11 17	12	38	35	19 54
11	20	38	8	11 38	12	18	41	20 4
12	20	26	30	11 58	11	58	37	20 17
13	20	14	32	12 18	11	38	20	20 27
14	20	2	14	12 40	11	17	53	20 39
15	19	49	34	12 58	10	57	14	20 49
16	19	36	36	13 18	10	36	25	20 59
17	19	23	18	13 37	10	15	26	21 9
18	19	9	41	13 57	9	54	17	21 19
19	18	55	44	14 15	9	32	58	21 29
20	18	41	29	14 34	9	11	31	21 38
21	18	26	55	14 52	8	49	53	21 45
22	18	12	3	15 9	8	28	8	21 53
23	17	56	54	15 29	8	6	15	22 2
24	17	41	25	15 43	7	44	13	22 9
25	17	25	42	16 2	7	22	4	22 17
26	17	9	40	16 19	6	59	47	22 23
27	16	53	21	16 34	6	37	24	22 30
28	16	36	47	16 51	6	14	54	22 37
29	16	19	56	17 8	5	52	17	22 42
30	16	2	48	17 22	5	29	35	22 48
31	15	45	26	17 38	5	6	47	22 54

Third yeare.	*September.*						*October.*					
	Declinat.			*Differ.*			*Declinat.*			*Differ.*		
Day.	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*		*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*	
1	4	43	53	22	58		6	55	57	22	48	
2	4	20	55	23	3		7	18	45	22	41	
3	3	57	52	23	7		7	41	26	22	37	
4	3	34	45	23	11		8	4	3	22	27	
5	3	11	34	23	15		8	26	30	22	21	
6	2	48	19	23	19		8	48	51	22	51	
7	2	25	0	23	21		9	10	42	22	29	
8	2	1	39	23	24		9	33	11	21	58	
9	1	38	15	23	26		9	55	9	21	49	
10	1	14	49	23	28		10	16	58	21	39	
11	0	51	21	23	31		10	38	37	21	31	
12	0	27	50	23	31		11	0	8	21	20	
13	0	4	19	23	32		11	21	28	21	10	
14	0	19	13	23	32		11	42	38	21	0	
15	0	42	45	23	33		12	3	38	20	48	
16	1	6	18	23	32		12	24	26	20	37	
17	1	29	50	23	33		12	45	3	20	25	
18	1	53	23	23	32		13	5	28	20	12	
19	2	16	55	23	30		13	25	40	20	0	
20	2	40	25	23	28		13	45	40	19	46	
21	3	3	53	23	20		14	5	26	19	34	
22	3	27	13	23	32		14	25	0	19	19	
23	3	50	45	23	22		14	44	19	19	4	
24	4	14	7	23	19		15	3	23	18	49	
25	4	37	26	23	16		15	22	12	18	34	
26	5	0	42	23	12		15	40	46	18	19	
27	5	23	54	23	7		15	59	5	18	3	
28	5	47	1	23	3		16	17	8	17	46	
29	6	10	4	22	59		16	34	54	17	29	
30	6	33	3	22	54		16	52	23	17	12	
31							17	9	35	16	53	

Third yeare.	November.			December.		
	Declinat.		Differ.	Declinat.		Differ.
Day.	Deg.	Mi. Se.	Mi. Se.	Deg.	Mi. Se.	Mi. Se.
1	17	26 28	16 36	23	4 48	4 47
2	17	43 4	16 18	23	9 35	4 18
3	17	59 22	15 58	23	13 53	3 50
4	18	15 20	15 37	23	17 43	3 23
5	18	30 57	15 22	23	21 6	2 53
6	18	46 19	14 57	23	23 59	1 26
7	19	1 16	14 40	23	25 25	2 58
8	19	15 56	14 18	23	28 23	1 28
9	19	30 14	13 56	23	29 51	1 1
10	19	44 10	13 35	23	30 52	0 32
11	19	57 45	13 12	23	31 24	0 4
12	20	10 57	13 50	23	31 28	0 25
13	20	24 47	11 28	23	31 3	0 54
14	20	36 15	12 4	23	30 9	1 22
15	20	48 19	11 41	23	28 47	1 51
16	21	0 0	11 17	23	26 56	2 19
17	21	11 17	10 53	23	24 37	2 47
18	21	22 10	10 28	23	21 50	3 16
19	21	32 38	10 4	23	18 34	3 44
20	21	42 42	9 38	23	14 50	4 11
21	21	52 20	9 14	23	10 39	4 41
22	22	1 34	8 47	23	5 58	5 1
23	22	10 21	8 22	23	0 57	5 42
24	22	18 43	7 55	22	55 15	6 3
25	22	26 38	7 29	22	49 12	6 30
26	22	34 7	7 3	22	42 42	6 56
27	22	41 10	6 35	22	35 46	7 24
28	22	47 45	6 9	22	28 22	7 52
29	22	53 54	5 41	22	20 30	8 16
30	22	59 35	5 13	22	12 14	8 44
31				22	3 30	9 8

Fourth yeare.	*Ianuary.*				*February.*			
	Declinat.			*Differ.*	*Declinat.*			*Differ.*
Day.	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*
1	21	54	22	9 36	14	7	8	19 52
2	21	44	46	9 59	13	47	16	20 5
3	21	34	47	10 26	13	27	11	21 19
4	21	24	21	10 50	13	5	52	19 31
5	21	13	31	11 14	12	46	21	20 43
6	21	2	17	11 3	12	25	38	20 55
7	20	51	14	12 37	12	4	43	21 7
8	20	38	37	12 26	11	43	36	21 17
9	20	26	11	12 48	11	22	19	21 28
10	20	13	23	13 11	11	0	51	21 39
11	20	0	12	13 34	10	39	12	21 48
12	19	46	38	13 55	10	17	24	21 57
13	19	32	43	14 17	9	55	27	22 6
14	19	18	26	14 39	9	33	21	22 15
15	19	3	47	14 59	9	11	6	22 23
16	18	48	48	15 20	8	48	43	22 30
17	18	33	28	15 40	8	26	13	22 37
18	18	17	48	16 0	8	3	36	22 45
19	18	1	48	16 19	7	40	51	22 52
20	17	45	29	16 37	7	17	59	22 57
21	17	28	52	16 57	6	55	2	23 49
22	17	11	55	17 14	6	31	13	22 22
23	16	54	41	17 31	6	8	51	23 13
24	16	37	10	17 50	5	45	38	23 19
25	16	19	20	18 6	5	22	19	23 22
26	16	1	14	18 22	4	58	57	23 25
27	15	42	52	18 39	4	35	32	23 29
28	15	24	13	18 54	4	12	3	23 32
29	15	5	19	19 9	3	48	31	23 35
30	14	46	10	19 24				
31	14	26	46	19 38				

Fourth yeare.	March.				April.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	3	24	56	23 37	8	35	11	21 51
2	3	1	19	24 3	8	57	2	21 43
3	2	37	16	23 17	9	18	45	21 33
4	2	13	59	23 41	9	40	18	21 24
5	1	50	18	23 42	10	1	42	21 14
6	1	26	36	23 43	10	22	56	21 3
7	1	2	53	23 43	10	43	59	20 53
8	0	39	10	23 43	11	4	52	20 42
9	0	15	27	23 44	11	25	34	20 31
10	0	8	17	23 39	11	46	5	20 20
11	0	31	56	23 40	12	6	25	20 8
12	0	55	36	23 38	12	26	33	19 56
13	1	19	14	23 27	12	46	29	19 43
14	1	42	41	23 43	13	6	12	19 29
15	2	6	24	23 31	13	25	41	19 18
16	2	29	55	23 27	13	44	59	19 4
17	2	53	22	23 25	14	4	3	18 50
18	3	16	47	23 20	14	22	53	18 36
19	3	40	7	23 15	14	41	29	18 22
20	4	3	22	23 13	14	59	51	18 6
21	4	26	35	23 7	15	17	57	17 52
22	4	49	42	23 2	15	35	49	17 36
23	5	12	44	22 56	15	53	25	17 21
24	5	35	40	22 51	16	10	46	17 5
25	5	58	31	22 44	16	27	51	16 49
26	6	21	15	22 37	16	44	40	16 32
27	6	43	52	22 31	17	1	12	16 15
28	7	6	23	22 24	17	17	27	15 58
29	7	28	47	22 16	17	33	25	15 41
30	7	51	3	22 8	17	49	6	15 23
31	8	13	11	22 0				

Fourth yeare.	May.				June.			
	Declinat.		Differ.		Declinat.		Differ.	
Day.	Deg.	Mi. Se.	Mi.	Se.	Deg.	Mi. Se.	Mi.	Se.
1	18	4 29	15	5	23	11 40	3	49
2	18	19 34	14	47	23	15 29	3	25
3	18	34 21	14	28	23	18 54	3	0
4	18	48 49	13	9	23	21 54	2	37
5	19	2 58	13	50	23	24 31	2	11
6	19	16 48	13	31	23	26 42	1	48
7	19	30 19	13	11	23	28 30	1	21
8	19	43 30	12	51	23	29 51	0	58
9	19	56 21	12	31	23	30 49	0	33
10	20	8 52	12	10	23	31 22	0	8
11	20	21 2	11	50	23	31 30	0	17
12	20	32 52	11	29	23	31 13	0	42
13	20	44 21	11	8	23	30 31	1	6
14	20	55 29	10	46	23	29 25	1	31
15	21	6 15	10	22	23	27 54	1	55
16	21	16 37	10	6	23	25 59	2	20
17	21	26 43	9	40	23	23 39	2	45
18	21	36 23	9	10	23	20 54	3	10
19	21	45 33	9	6	23	17 44	3	33
20	21	54 39	8	33	23	14 11	3	57
21	22	3 12	8	11	23	10 13	4	22
22	22	11 23	7	47	23	5 51	4	46
23	22	19 10	7	25	23	1 5	5	10
24	22	26 35	7	1	22	55 55	5	35
25	22	33 36	6	38	22	50 20	5	55
26	22	40 14	6	14	22	44 24	6	22
27	22	46 28	5	50	22	38 2	6	45
28	22	52 18	5	26	22	31 17	7	9
29	22	57 44	5	3	22	24 8	7	31
30	23	2 47	4	38	22	16 37	7	54
31	23	7 25	4	15				

Fourth yeare.	July.					August.				
	Declinat.			Differ.		Declinat.			Differ.	
Day.	Deg.	Mi.	Se.	Mi.	Se.	Deg.	Mi.	Se.	Mi.	Se.
1	22	8	43	8	17	15	14	18	18	5
2	22	0	26	8	39	14	56	13	18	18
3	21	51	47	9	3	14	37	55	18	32
4	21	42	44	9	24	14	19	23	18	46
5	21	33	20	9	46	14	0	37	18	59
6	21	23	34	10	8	13	41	38	19	13
7	21	13	26	10	29	13	22	25	19	26
8	21	2	57	10	51	13	2	59	19	37
9	20	52	6	11	11	12	43	22	19	50
10	20	40	55	11	33	12	23	32	20	2
11	20	29	22	11	55	12	3	30	20	14
12	20	17	27	12	13	11	43	16	20	25
13	20	5	14	12	34	11	22	51	20	36
14	19	52	40	12	53	11	2	15	20	46
15	19	39	47	13	13	10	41	29	20	57
16	19	26	34	13	34	10	20	32	21	3
17	19	13	0	13	52	9	59	29	21	20
18	18	59	8	14	10	9	38	19	21	25
19	18	44	58	14	29	9	16	44	21	35
20	18	30	29	14	48	8	55	9	21	44
21	18	15	41	15	5	8	33	25	21	52
22	18	0	36	15	24	8	11	33	21	59
23	17	45	12	15	40	7	49	34	22	8
24	17	29	32	15	58	7	27	26	22	15
25	17	13	34	16	14	7	5	11	22	21
26	16	57	20	16	31	6	42	50	22	28
27	16	40	49	16	47	6	20	22	22	35
28	16	24	2	17	3	5	57	47	22	41
29	16	6	59	17	19	5	35	6	22	47
30	15	49	40	17	34	5	12	19	22	52
31	15	32	6	17	48	4	49	27	22	58

Fourth yeare.	September.				October.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	4	26	29	23 2	7	13	13	22 44
2	4	3	27	23 6	7	35	57	22 34
3	3	40	21	23 10	7	58	34	22 30
4	3	17	11	23 14	8	21	4	22 22
5	2	53	57	23 18	8	43	26	22 17
6	2	30	39	23 21	9	5	43	22 8
7	2	7	18	23 22	9	27	51	21 58
8	1	43	56	23 27	9	49	49	21 52
9	1	20	29	23 27	10	11	41	21 42
10	0	57	2	23 29	10	33	23	21 33
11	0	33	33	23 31	10	54	56	21 23
12	0	10	2	23 32	11	16	19	21 13
13	0	13	30	23 33	11	37	32	21 2
14	0	37	3	23 32	11	58	34	20 51
15	1	0	35	23 34	12	19	25	20 39
16	1	24	9	23 32	12	40	4	20 28
17	1	47	41	23 31	13	0	32	20 16
18	2	11	12	23 31	13	20	48	20 3
19	2	34	43	23 29	13	40	51	19 49
20	2	58	12	23 28	14	0	40	19 36
21	3	21	40	23 26	14	20	16	19 23
22	3	45	6	23 22	14	39	39	19 8
23	4	8	28	23 19	14	58	47	18 53
24	4	31	47	23 17	15	17	40	18 38
25	4	55	4	23 12	15	36	18	18 22
26	5	18	16	23 9	15	54	40	18 7
27	5	41	25	23 5	16	12	47	17 50
28	6	4	30	23 0	16	30	37	17 33
29	6	27	30	22 54	16	48	10	17 16
30	6	50	24	22 49	17	5	26	16 58
31					17	22	24	16 41

Fourth yeare.	November.						December.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	17	39	5	16	21		23	8	28	4	25	
2	17	55	26	16	3		23	12	53	3	57	
3	18	11	29	15	44		23	16	50	3	29	
4	18	27	13	15	24		23	20	19	3	1	
5	18	42	37	15	3		23	23	20	2	33	
6	18	57	40	14	45		23	25	53	2	4	
7	19	12	25	14	23		23	27	57	1	45	
8	19	26	48	14	1		23	29	32	1	8	
9	19	40	49	13	40		23	30	40	0	39	
10	19	54	29	13	18		23	31	19	0	11	
11	20	7	47	12	55		23	31	30	0	18	
12	20	20	42	12	34		23	31	12	0	48	
13	20	33	16	12	9		23	30	24	1	14	
14	20	45	25	11	48		22	29	10	1	44	
15	20	57	12	11	23		23	27	26	2	13	
16	21	8	35	10	59		23	25	13	2	40	
17	21	19	34	10	34		23	22	33	3	9	
18	21	30	8	10	9		23	19	24	3	37	
19	21	40	17	9	46		23	15	47	4	5	
20	21	50	3	9	19		23	11	42	4	34	
21	21	59	22	8	53		23	7	8	5	0	
22	22	8	15	8	28		23	2	8	5	29	
23	22	16	43	8	2		22	56	39	5	56	
24	22	24	45	7	36		22	50	43	6	23	
25	22	32	21	7	9		22	44	20	6	51	
26	22	39	30	6	42		22	37	29	7	10	
27	22	46	12	6	15		22	30	19	7	52	
28	22	52	27	5	48		22	22	27	8	11	
29	22	58	15	5	20		22	14	16	8	36	
30	23	3	35	4	53		22	5	40	9	3	
31							21	56	37	9	26	

CHAP. XXVIII.

The vse of the former table, or regiment of the Sunne.

THis table of the Sunnes declinations, as it differeth nothing in forme from others that haue bin published heretofore: so likewise the maner of vsing it, is altogether the same that hath bin accustomed in former tables of this kind, sauing that I must giue warning of one error that hath bin committed herein; which is (as I haue obserued) that some of our seamen doe take the Suns declination out of their regiments, without any æquation by addition or subtraction of the part proportionall, agreeable to the difference of longitude of the place where they are, as if they were alwaies at the same place, or vnder the same meridian, for which their regiments were made. For which cause alone, (though they auoid all other errors) it may so fall out, that they may be deceiued sometimes 10, or 12 minutes (or more in a long voyage) in taking the Sunnes declination. For there is not any table of the Sunnes declination, but that it must needes be made for some one meridian (as this former table was made for the meridian of *London*) and therefore cannot be truely vsed in any other, without some æquation answerable to the distance of the meridians or difference of longitude.

To auoid this error therefore, first learne how much you differ in longitude from the place for which

which your table was made, (and though you misse halfe a dozen, or halfe a score degrees herein, it cannot in this point breed any sensible error). Secondly, take out the difference of the Sunnes declination, agreeable to the space of 24 houres, about the time of your obseruation. Thirdly, as 360 is to this difference of declination; so is the difference of longitude to the part proportionall, or æquation of the declination; which æquation is to be added to the declination of the day of obseruation, if the declination of the Sunne be either increasing, and the place of obseruation westward; or else decreasing, and the place of obseruation eastwards from the place for which your table of declination was made: otherwise this æquation is to be subtracted from the declination of your day of obseruation, that you may haue the true declination of the Sunne, for the time and place of your obseruation.

But if the time of your obseruation be the noontide immediatly before or after the Suns entrance into either of the æquinoctiall points, you must follow another rule, and that is this: diuide the difference of longitude by 15, marke how many vnities the quotient conteineth, and so many minutes adde to the declination found in the former table, if you be either eastward from the meridian of *London*, & obserue the noontide before the æquinoctium: or if you be westward from that meridian, and obserue the noontide after the æquinoctiũ, for the sum shall be the declination desired. Otherwise, if you be either westward from the meridian of *London*, and obserue the noonetide next before the æquinoctium,

um, or eastward from that meridian, and obserue the day immediatly after the æquinoctium, compare the declination found in the table with the foresaid quotient, and subtract the lesser out of the greater, for that remaineth is the declination desired. Which declination hath the same denomination of north or south that the table sheweth, if the quotient be lesse then the declination found in the table: but if the quotient be greater, the denomination must be altered from north to south, or from south to north, contrary to that the table sheweth. If the quotient be equall to the declination found in the former table, the Sunne is in the very æquinoctiall point, and hath no declination at all.

A few examples wil make these rules more plaine: suppose therefore the 30 of March 1610, you were sailing in the bay of *Mexico*, differing in longitude to the westwards from the meridian of *London*, about 90 degrees by æstimation: the declination of the Sunne for that day found in the former table, is 7 degrees, 39 minutes, 35 seconds, the difference of the declination in 24 houres at that time, 22 minutes, 13 seconds. Now as 360 is to 22 minutes, 13 seconds; so is 90 degrees to 5 minutes, 33 seconds, (the part proportionall or æquation desired) which becauſe the declination increaseth, and the bay of *Mexico* is also westward from the meridian of *London*, must be added to the declination before found in the table, and so shall you haue the true declination of the Sunne that day at noone for that place, 7 degr. 45 min. 8 sec. But admit you had sailed eastwards, and were in the East Indian Ocean sea, differ-

ring likewise in longitude frō *London* about 90 deg. therefore the difference of declination, and the part proportionall thereof, or æquation of the declination shall be the same they were before. But because you are gone so much eastwards, the Sunne commeth 6 houres sooner to your meridian there, then it doth to ours here at *London*: and therefore because the declination also is increasing, and will be greater when the Sunne commeth to our meridian then it was, the Sunne being vnder the meridian of the East Indies, that æquation of declination must there be subtracted out of the declination found in the table, which before was to be added when we supposed you to be in the bay of *Mexico*, because the Sunne commeth later by six houres to the meridian of that place, then to ours, and therefore the declination of the Sunne increasing in the meane time, will be greater there then here.

Now imagine you saile in the yeere 1612 through the Streights of Magellane, & hauing passed ouer the south sea, come the 12 of September to the Philippinas, differing in longitude from *London* westwards about 210 degrees.

In this example, because the Sunne is neere the æquinoctiall point (altering his declinatiō about 24 min. in 24 houres, that is, for euery houre one minute) therefore diuide 210 (the difference of longitude) by 15 (the number of degrees contiened in one houre) the quoteint will be 14 minutes (the difference of declination answerable to that difference of longitude.) The declination found in the table for that day is 10 minutes, 2 seconds northerly: which

which (declination) becauſe it decreaſeth (the Sun not being yet comne to the æquinoctiall) muſt be ſubtracted out of 14, and there ſhall remaine 3 min. 58 ſec. the declination of the Sun that day at noone, for that place. But this declination is ſoutherly, becauſe the quotient 14 min. is greater then 10 min. 2 ſec. the declination found in the table. It would be at this time too tedious for me further to exemplifie euery particularity ſpecified in the former rules, which may cauſe ſome ſmall diuerſitie in the vſe of the Sunnes declination, hauing already giuen examples of the hardeſt caſes that may befall herein, which if they be well conſidered, and eſpecially compared with the Globe or Sphære, (wherein the whole manner of the Sunnes motion and declination may moſt eaſelie, not onely be ſeene, but alſo felt as it were with the fingers ends) the reaſon and demonſtration of all thoſe rules, and of all the diuerſities of working therein ſpecified, may moſt plainly appeare to him that is but of a meane capacitie.

Chap. XXIX.

The declinations of the principall fixed ſtarres about the Æquinoctiall, corrected by obſeruation.

BVt becauſe the declination of the Sun is then only of good vſe for knowing the latitude at ſea, when his meridian altitude may be obſerued: ſo as although all the reſt of the day and night be faire and cleere, if a cloude couer the Sun but one quarter of an houre only, about noone, your tables of the Sunnes decli-

nation will ſtand you in no ſtead: there haue been therefore other meanes deuiſed for attaining to the knowledge of the height of the Pole, not only in particular, by obſeruation of the Pole-ſtar and guards, but alſo in generall by the meridian altitude and declination of any notable fixed ſtarre whatſoeuer. So as not in the day time alone, and that onely at noone, but almoſt at any time of the night, if any ſmall portion of the heauens towards the north or ſouth, appeare but a ſmall time cleere through the raking cloudes, the latitude of the place where you are, may hereby bee more eaſilie knowne, then by obſeruation of the Suns meridian altitude. For to omit the changing of the Sunnes declination from north to ſouth, and from ſouth to north twice in euery yeere, which notwithſtanding breedeth ſome diuerſity of working (by neglect whereof ſome haue groſly erred) the Sunne by reaſon of his ſwiftneſſe of motion, increaſeth or diminiſheth his declination daily, yea hourely, and that very ſenſibly many times, whereof there muſt needs ariſe many ſeuerall conſiderations to be had of the right vſe and application of the Sunnes declination found in the table, as wel in reſpect of the part of declination, (whether it be north or ſouth) as alſo in regard of the difference of longitude betweene the place, for which the tables of the Sunnes declination were made, and the place of obſeruation, whether it be eaſterly or weſterly from thence, beſides many other particularities lately related, and needleſſe here to be repeated. But the fixed ſtarres moouing ſo exceeding ſlowly, that in more then 70 yeeres, they go

not

not ſo much as one degree in their proper motion from the weſt eaſtwards, keep not only the ſame part of the north, or ſouth, but almoſt the ſame point and minute of decliuation for many yeeres together, I meane thoſe ſtarres eſpecially that are placed in the ſignes of *Gemini*, *Cancer*, *Sagitarie*, or *Capricorne*, neere the ſolſtitiall colure, which in an hundred yeeres or two, can alter their declination ſcarce one minute: whereas thoſe ſtarres that bee in *Piſces*, *Aries*, *Virgo*, or *Libra*, eſpecially if they be neere the æquinoctiall colure, may differ in their declinations about one minute in 3 yeeres; which differẽce, though it be ſomething, yet for a dozen or twenty yeeres, will hardly be ſo much as can at ſea be obſerued by any inſtrument hitherto had in vſe there.

For theſe two cauſes therefore (that is, for the more eaſie and generall vſe of the declinations of the fixed ſtarres then of the Sun) I wiſh they were more generally knowne and obſerued by our ſeamen then they are, as whereby they might not only moſt eaſily know the eleuation of the Pole at any time of the night, but alſo in any place of the world, much more commodiouſly then otherwiſe they can, becauſe that in what latitude, and how farre ſoeuer they ſhould come either northwards or ſouthwards, they might alwaies haue their choice of diuers fixed ſtarres neere the meridian, both towards the north and ſouth, of a conuenient height to be obſerued. But herewith it were alſo to be wiſhed, that the tables of the fixed ſtarres declinations, which are moſt common amongſt Engliſh mariners, had been more free from error then they are: I meane eſpeci-

ally the tables publiſhed in *Bournes* Regiment, and *Normans* new Attractiue, which (tables agreeing almoſt in euery tittle one with another) ſeeme to be taken word for word one out of another, errors and all; ſo as you cannot finde any error in the one, but you ſhall be ſure alſo to haue the ſame in the other: notwithſtanding ſome of thoſe errors are more then two or three whole degrees, (which becauſe being neglected, or vnknowne to the mariner that ſhall vſe thoſe tables) they may bring him in greater danger then many a hidden rocke vnder ſea: I haue therefore by diligent obſeruation, with a quadrant of more then ſix foote ſemidiameter, detected and corrected thoſe errors, ſhewing not onely the truth to be heedfully followed, but thoſe errors alſo to be as carefully auoided, in ſuch ſort as is ſet downe in the table following, wherein the firſt columne conteineth the names of the ſtarres; the ſecond, the true declinations (as they were found by obſeruation) in degrees and minutes, together with the part of declination, ſignified by the letters N and S, whereof N ſignifieth the declination to be north, and S, ſouth. The third columne containeth the declinations publiſhed in *Bournes* and *Normans* tables. The fourth ſheweth the difference of theſe declinations from the trueth. The fift giueth the right aſcenſions of thoſe ſtarres, reſolued into houres and minutes. In the ſixt and laſt columne are ſet downe the magnitudes or bigneſſe of the ſame ſtarres.

found about the yeare 1594

Fixed

The names of the starres.	*Declinat. by obseru.*			*B. & N. Declin.*		*Differ-ence.*		*Right ascens.*		*Big-nesse.*
	Deg.	*Min.*		*De*	*Mi.*	*D.*	*Mi.*	*Ho.*	*Mi.*	
Whales back	12	20	*S*	12	11		9	0	50	3
Whales bellie	12	22	*S*	12	20		2	1	32	3
Rammes horne	17	17	*N*	17	19		2	1	32	3
Rammes head	21	33	*N*	21	16		17	1	46	3
Bulles eye	15	38	*N*	15	42		4	4	13	1
Orions left foote	8	43	*S*	9	14		29	4	55	1
Orions left shoulder.	5	56	*N*	4	37	1	19	5	4	2
First in Orions girdle.	0	38	*S*	1	19		41	5	12	2
Orions right shoulder.	6	17	*N*	6	18		1	5	34	1
Great dogge.	16	12	*S*	15	30		42	6	27	1
Lesser dogge.	6	13	*N*	6	4		9	7	18	1
Brightest in Hydra	6	53	*S*	4	47	2	6	9	8	2
Lions heart.	13	55	*N*	21	59		17	9	57	1
Lions neck	21	52	*N*	14	3		8	9	46	2
Lions back	22	43	*N*	22	30		13	10	52	2
Lions taile	16	50	*N*	16	46		4	11	29	1
Rauens head	20	45	*S*	19	53		52	11	50	3
Rauens wing.	15	16	*S*	17	8	1	52	11	56	3
Virgins spike	9	0	*S*	8	53		7	13	5	1
Betwixt Bootes thighs	21	20	*N*	22	9		49	13	56	1
South Ballance	14	14	*S*	13	44		30	14	30	2
North Ballance	7	46	*S*	7	33		13	14	55	2
Scorpions hart.	25	25	*S*	24	47		38	16	6	1
Hercules head	14	57	*N*	15	20		23	16	56	3
Serpentaries head	12	57	*N*	14	7	1	10	17	16	3
Eagles hart	17	54	*N*	7	28		26	19	32	2
Dolphins taile	10	0	*N*	10	1		1	20	16	3
Goates taile.	17	51	*S*	14	13	3	38	21	27	3
Water powrers leg	18	10	*S*	15	52	2	18	22	35	3
Pegasus shoulder.	12	58	*N*	13	1		3	22	46	2
Pegasus leg	25	58	*N*	26	30		32	22	44	2
Whales taile.	20	12	*S*	21	47	1	35	0	24	3

Chap. XXX.
The vse of the former Table.

THe declinations of the fixed stars conteined in this table, being to be vsed altogether after the same maner, as the declination of the Sun, for finding out the height of the Pole; it would be but needlesse for me in this place, to write any more of the vse thereof, being a thing so easie and so commonly knowne amongst mariners, and already sufficiently deliuered by others.

Chap. XXXI.
The true distances of certaine principall fixed starres from the north pole, found by late obseruation.

BVt seeing this former table conteineth almost no other starres, but such as are betwixt the tropicks, and neer about the æquinoctiall circle, which are not so fit to be obserued by them that saile farre southwards, or vnder the burnt Zone, (for there they will be too high aboue the horizon) I thought good here to adioine an other table of as many more principall fixed starres (heedfully obserued also with the same quadrant) that are placed neere about the north Pole, which may stand you in as much stead, as twice so many taken out of other parts of the heauens, because they come twice to the meridian aboue our horizon, in euery 24 houres: so as in winter time manie of them may be obserued both euening & morning, twice in one night, both aboue and beneath the Pole. Notwithstanding, for them that saile northwards, it shall be best to obserue these starres when they come to the meridian vnder the

the Pole. Contrariwise, they that trauell farre southwards, may best obserue their meridian altitudes aboue the Pole. Herein also this table differeth from the former; that whereas in the former were set downe the declinations of the stars, or their distances from the æquinoctiall; in this contrariwise are set downe the complements of their declinations, or their distances from the Pole; whereby the height of the Pole may more easily be found, then by their declinations, onely by adding the height of the star obserued beneath the Pole, to the distance thereof from the Pole: or by subtracting onely the distance of the star from the Pole out of the northerly meridian altitude, obserued aboue the Pole. But if the meridian altitude of the star be southerly (the starre obserued being southwards from the Zenith) subtract the height of the star from 180, and out of the remainder subtract the distance of the starre from the Pole; so shall you haue the height of the Pole: thus also there would be a more easie way, then that is commonly vsed for knowing the latitude by the Sun or stars, hauing southerly declination. For if in stead thereof, the complement of declination were set downe in the table; the height of the Sun or stars alwaies subtracted out of this complement, should leaue you the height of the Pole, or latitude desired.

But to returne to the table of fixed stars here following, the first columne therein conteineth (as before) the names of the stars: the second, their complements of declination, or distances from the Pole: the third columne giueth you their right ascensions reduced into houres, and minutes of an houre: the fourth sheweth their bigneſſe or magnitudes.

The

The names of the Starres.	Distance from the Pole.		Right ascension.		Bigneſſe.
	De.	Mi.	Ho.	Mi.	
In the breaſt of Caſſiopeia	35	35	0	19	3
In her lip.	31	26	0	32	3
The Pole ſtarre.	2	52	0	50	3
At the knees of Caſſiopeia.	31	50	1	0	3
In her leg.	28	18	1	25	3
Perſeus right ſhoulder.	38	5	2	35	3
Perſeus right ſide.	41	38	2	56	2
The goate, or wagoners left ſhoulder.	44	30	4	49	1
The wagoners right ſhoulder.	45	11	5	30	2
The firſt in the great beares fore foot	40	30	8	24	3
The ſecond in the ſame foote.	41	28	8	32	3
In her former left knee.	36	37	8	58	3
The great beares ſide.	31	26	10	58	3
+ The great beares back.	26	5	10	40	2
The end of the Dragons taile.	18	26	11	8	3
The great beares thigh.	34	3	11	32	2
The great beares rump. (taile.	30	41	11	54	2
The next to the end of the Dragons	17	57	12	14	3
The 1 in the great beares taile next	31	49	12	32	2
The middlemoſt in her taile (her rump.	32	55	13	6	2
In the end of her taile.	38	37	13	32	2
The next before the turning of the	23	40	13	53	3
The formoſt guard. (dragons taile.	14	11	14	54	2
In the turning of the dragons taile.	29	37	15	14	3
The hindmoſt guard.	16	42	15	26	2
Next after the turning of the Dra-	30	20	15	54	3
The Dragons eye. (gons taile.	37	18	17	22	3
The Dragons head.	38	22	17	44	3
In the Swans right wing.	45	44	19	34	3
In her taile.	46	6	20	30	2
Cepheus his right ſhoulder.	29	0	21	10	3
The back of Caſſiopeiaes chaire.	33	2	23	48	3

CHAP.

Chap. XXXII.

To know at what time any of the foresaid fixed starres come to the meridian for any day of the yeere.

NOW because the fixed starres are then onely meete to be obserued for finding the latitude when they are in the meridian; it is therefore good for him that meaneth to obserue them, to know at what time they come to the meridian. To this end there are tables published; and almost in euery mariners hands, pretending to shew at what houre and minute euerie starre in the first of these two former tables commeth to the meridian, for the beginning and midst of euerie moneth in the yeere, agreeing likewise in euerie error one with another: but because these errors breed not (at any time) greater danger or damage to the Mariner that is ware of them, then to make him watch for their comming to the meridian, a quarter, or halfe an houre longer then otherwise he needed (this inconuenience only prouided for) those tables may serue the turne well enough, for them that list not trouble themselues to learne a better way.

But for them that are desirous of a more true and generall way, I haue also made the table following of the Sunnes right ascensions, reduced into houres and minutes (for euery day of this present yeere 1599, according to the Ephemerides of the Sunne, before set downe: with helpe of which table, it may easily be known for any day of any yeere in our age,

1599

at

at what time not onely any of the foresaid fixed stars about the æquinoctiall, but those also about the pole, or any other, (whose right ascensions are knowne in houres and minutes) come to the meridian, and that after this maner. Finde out in the table following the moneth and day wherein you obserue; the moneth in the vpper margine of the table, the day in the first columne thereof next the left hand, the common meeting of the columne descending from the moneth, and of the line proceeding from that day towards the right hand, shall giue you the Sunnes right ascension in houres and minutes for the same day. This right ascension of the Sunne, subtract alwaies out of the right ascension of the starre, adding 24 houres to the starres right ascension, if it be lesse then the right ascension of the Sun: the remainder sheweth how many houres and minutes after noone, the starre commeth to the vpper part of the meridian; which if they be more then 12 houres, subtract 12 from them, and the remainder shall shew you how many houres and minutes after midnight the star commeth to the vpper part of the meridian. The vpper part of the meridian I call that which passeth from the Pole, by the Zenith to the Horizon southwards. But it shall be needfull also many times when you would obserue the starres about the Pole (which neuer set) to know the time of their comming to the nether part of the meridian, which may easily be done, onely by adding twelue houres to the time of their comming to the vpper part of the meridian, if it be lesse then 12 houres, or by subtracting as much if it be more.

Suppose

Suppoſe for example, the 25 of Februarie 1599, I would know the time of the great dogs commming to the meridian. Firſt therefore (in the next table) following the columne deſcending from Februarie downewards, and the line proceeding from the 25 day towards the right hand, in the common meeting of them both, I finde 23 houres, 10 min. the Suns right aſcenſion that day at noone. Then in the firſt table of fixed ſtarres, I finde the great dogs right aſcenſion to be 6 degrees, 27 minutes; to which (becauſe it is leſſe then the Suns right aſcenſion) I adde 24 houres, and the ſumme of both commeth to 30 houres, 27 minutes; out of this I ſubtract the Sunnes right aſcenſion, 23 houres, 10 minutes, and there remaine 7 houres, 17 minutes, the time of the great dogs comming to the vpper part of the meridian in the after noone.

Take one example alſo of a ſtarre that neuer ſetteth: and admit the 20 of December the ſame yeere, you would know what time the formoſt guard commeth to the Meridian beneath the Pole: Firſt therefore you ſhall finde, as before, the Sunnes right aſcenſion that day to be 18 houres, 36 minutes: and the right aſcenſion of that ſtarre (in the ſecond table of fixed ſtarres) 14 houres, 54 minutes, to which (being leſſe then the Suns right aſcenſion) adde 24 houres, and from the ſum (38 houres, 24 minutes) ſubtract the Sunnes right aſcenſion 18 houres, 36 minutes: ſo there ſhall remaine 20 houres, 18 minutes, the time of the foreguards comming to the vpper part of the meridian, from which ſubtract 12, ſo you haue the time when it commeth to the nether part of the meridian, 8 houres, 18 minutes after noone.

A Table of the Sunnes right ascension in houres

	Ianuary.		Febru.		March.		Aprill.		May.		Iune.	
Day.	Ho.	Mi.	Ho.	Mi.	Ho.	Mi.	Ho.	M.	Ho.	M.	Ho.	M.
1	19	30	21	39	23	25	1	18	3	11	5	15
2	19	34	21	43	23	28	1	22	3	15	5	19
3	19	39	21	47	23	32	1	26	3	19	5	25
4	19	43	21	50	23	36	1	29	3	23	5	27
5	19	47	21	54	23	40	1	33	3	27	5	31
6	19	52	21	58	23	44	1	36	3	30	5	36
7	19	56	22	2	23	47	1	40	3	34	5	40
8	20	0	22	6	23	51	1	43	3	38	5	45
9	20	4	22	9	23	55	1	47	3	42	5	49
10	20	8	22	14	23	58	1	51	3	46	5	53
11	20	13	22	18	0	2	1	55	3	50	5	57
12	20	17	22	21	0	6	1	58	3	54	6	1
13	20	22	22	25	0	9	2	2	3	58	6	5
14	20	26	22	29	0	12	2	6	4	3	6	9
15	20	30	22	32	0	16	2	10	4	7	6	13
16	20	34	22	36	0	20	2	14	4	11	6	18
17	20	38	22	40	0	23	2	18	4	15	6	22
18	20	42	22	44	0	27	2	22	4	19	6	36
19	20	46	22	48	0	31	2	26	4	23	6	30
20	20	50	22	52	0	35	2	30	4	27	6	34
21	20	54	22	56	0	38	2	33	4	31	6	38
22	20	58	22	59	0	42	2	37	4	35	6	42
23	21	3	23	3	0	46	2	41	4	39	6	46
24	21	7	23	7	0	49	2	44	4	43	6	51
25	21	11	23	10	0	53	2	48	4	47	6	55
26	21	15	23	14	0	57	2	52	4	51	6	59
27	21	19	23	18	1	0	2	56	4	56	7	3
28	21	23	23	22	1	3	3	0	5	0	7	7
29	21	27			1	7	3	4	5	3	7	11
30	21	31			1	11	3	7	5	7	7	15
31	21	35			1	15			5	11		

and minutes for euery day of the yeare.

	Iuly.	*Aug.*	*Septem.*	*Octob.*	*Nou.*	*Decem.*
Day.	*Ho. M*	*Ho. M.*	*Ho. M*	*Ho. M.*	*Ho. M.*	*Ho. M.*
1	7 19	9 22	11 16	13 5	15 5	17 12
2	7 23	9 26	11 20	13 8	15 9	17 17
3	7 27	9 30	11 23	13 12	15 13	17 21
4	7 31	9 33	11 27	13 16	15 17	17 25
5	7 35	9 36	11 30	13 19	15 21	17 30
6	7 40	9 40	11 33	13 23	15 25	17 34
7	7 44	9 44	11 37	13 27	15 29	17 39
8	7 48	9 48	11 41	13 31	15 33	17 43
9	7 52	9 52	11 44	13 34	15 37	17 47
10	7 56	9 56	11 48	13 38	15 42	17 52
11	8 0	9 59	11 52	13 42	15 46	17 56
12	8 4	10 3	11 55	13 45	15 50	18 0
13	8 8	10 7	11 59	13 49	15 54	18 5
14	8 12	10 11	12 3	13 53	15 58	18 10
15	8 16	10 15	12 7	13 57	16 3	18 14
16	8 20	10 18	12 11	14 1	16 7	18 18
17	8 24	10 22	12 14	14 5	16 11	18 23
18	8 28	10 26	12 18	14 9	16 16	18 27
19	8 31	10 29	12 22	14 13	16 20	18 32
20	8 35	10 33	12 25	14 17	16 24	18 36
21	8 39	10 36	12 29	14 20	16 28	18 41
22	8 43	10 40	12 32	14 24	16 33	18 45
23	8 47	10 44	12 36	14 28	16 37	18 50
24	8 52	10 47	12 40	14 32	16 41	18 55
25	8 55	10 51	12 43	14 36	16 46	18 59
26	8 59	10 54	12 47	14 40	16 50	19 3
27	9 3	10 58	12 51	14 44	16 55	19 7
28	9 7	11 2	12 54	14 48	16 59	19 12
29	9 11	11 6	12 58	14 53	17 3	19 16
30	9 15	11 9	13 2	14 57	17 8	19 21
31	9 19	11 13		15 1		19 25

Chap. XXXIII.

By the former tables of the fixed ſtarres, and the Sunnes right aſcenſions, to know the houre of the night, at any time of the yeere.

BY theſe tables of fixed ſtarres, and right aſcenſions of the Sunne, you may eaſily know alſo the houre of the night at any time of the yeere, after this maner: looke which of thoſe ſtarres is at the meridian, which may eaſily be knowne by a needle diall or Compaſſe: or if you will obſerue the north ſtarres that neuer ſet, (which indeed are fitteſt for this purpoſe, eſpecially when they come to the meridian vnder the Pole) you ſhall firſt finde the place of the Pole in the heauens, ſo neere as you can by eſtimation (for a little error herein, breakes no ſquare) which may be done thus: From the Pole ſtar directly towards the firſt ſtarre next the rumpe in the Great Beares taile, imagine almoſt ſo much ſpace as the guards are diſtant aſunder, for neere thereabouts is the place of the Pole. Now betwixt your eye, and this place of the Pole, hold a plumbeline hanging as perpendicularly, and ſtedfaſtly as you may, and marke withall if that plumbeline come betwixt your ſight, and any of the ſtarres noted in the table of fixed ſtarres about the Pole; for that ſtarre is at the meridian. Then learne (as before was ſhewed) at what time that ſtar commeth to the meridian, and ſo you ſhall haue the houre of the night.

Suppoſe for example, the 10 of February you finde

finde after this manner the Swans taile at the meridian, vnder the Pole, desiring hereby to know the houre of the night at that time. The right ascension of the Sunne for that day, you shall finde as before, to be 22 houres, 14 minutes, whereto you may adde a minute or two more (because that starre will come to the meridian very late in the euening) so making the Suns right ascension 22 houres, 16 minutes. The right ascension of that starre in the second table of fixed starres, you shall finde to be 20 houres, 30 minutes. From which (because now you desire to know the time of that starres comming to the nether part of the meridian) you may subtract 12 houres, and there shal remaine 8 houres, 30 minutes. To this remainder (because it is lesse then the Suns right ascension) adde 24 houres, and from the sum (32 houres, 30 minutes) subtract the right ascension of the Sunne 22 houres, 16 minutes, so there shall remaine 10 houres, 14 minutes, the time of the night desired.

Chap. XXXIIII.

Of finding the eleuation of the Pole, by obseruation of the pole-starre and guard.

BEsides the waies already spoken of to finde the eleuation of the Pole by the meridian altitudes, and declinations of the Sunne and fixed starres in generall: there hath been also vsed another way more special, by the height of the pole-star, when the foreguard is situate from it, either to-

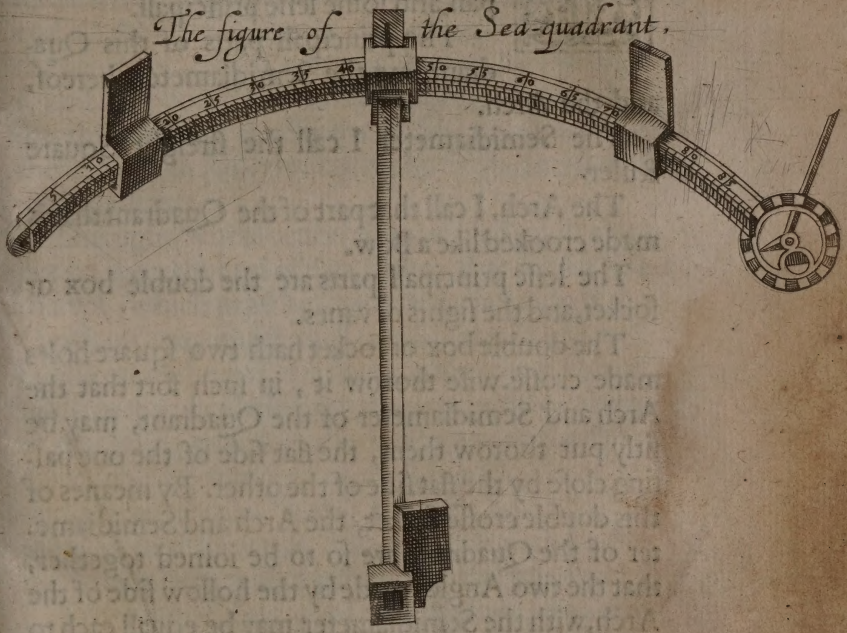
wards the eaſt, weſt, north, or ſouth, or elſe vpon the middle points betwixt theſe principall, as vpon the northeaſt, northweſt, ſoutheaſt, & ſouthweſt points. Of which way, as it hath bin hitherto publiſhed and vſed, I muſt for the preſent onely giue the Mariner warning that he truſt not to it, being very erroneous, and grounded vpon two falſe poſitions. The one is, that the diſtance of the pole-ſtarre from the Pole, is three degrees, 30 minutes, which by often and exact obſeruation, is found to be at this time not aboue 2 deg. 48 min. The other is that æquations or allowances to be added to, or ſubtracted from the height of the pole-ſtarre, to finde thereby the height of the Pole, are made the ſame for all latitudes.

But hauing already ſhewed ſufficiently how to know the latitude almoſt at any time of the night, by the fixed ſtarres in the former tables, I hope to be the eaſelier excuſed for finding a fault herein, and not amending it at this time, and that ſo much the rather, becauſe that (according to the promiſe made in the firſt edition of this booke) I will now ſhew the meanes how by obſeruation of the pole-ſtar and guards, to finde preſently the height of the Pole; not onely when the foreguard is in ſome one of thoſe eight principall poſitions before mentioned, as the manner hath been hitherto; but in any other poſition alſo, and at any time of the night, when the pole-ſtarre and guards may be ſeene, and that without any allowance or abatement, giuing or taking, by addition or ſubtraction of any æquation, in regard of the pole-ſtarres being higher or lower then the Pole. All which, beſides diuers other pleaſant

and

and profitable conclusions, may easily bee performed by meanes of an instrument by mee deuised, which may not vnfitly be called the Sea Quadrant, the description and vse whereof here followeth.

The figure of the Sea-quadrant.



Chap. XXXVI.

The description and parts of the Sea Quadrant.

THis Quadrant consisteth of many parts, whereof some may be called principall, and some lesse principall.

The principall parts of this Quadrant, are the Semidiameter thereof, and the Arch.

The Semidiameter I call the streight Square Ruler.

The Arch, I call that part of the Quadrant that is made crooked like a Bow.

The lesse principall parts are the double box or socket, and the sights or vanes.

The double box or socket hath two square holes made crosse-wise thorow it, in such sort that the Arch and Semidiameter of the Quadrant, may be fitly put thorow them, the flat side of the one passing close by the flat side of the other. By meanes of this double crosse socket, the Arch and Semidiameter of the Quadrant are so to be ioined together, that the two Angles made by the hollow side of the Arch, with the Semidiameter, may be equall each to other.

The sights or vanes, are either fixed or moueable.

There be two fixed sights, the one greater, the other lesser.

The greater fixed sight is fastened vpon the double socket, and hath a narrow slit cut through the midst thereof.

The

The leſſer fixed ſight is faſtened to the end of the Arch of the Quadrant, and hath a ſmall ſight hole bored thorow it, euen with the end of the Arch.

The moueable ſights are three in number; whereof two are to be moued vp and downe vpon the Arch of the Quadrant, as need ſhall require for obſeruation. The third is to be put on, or taken off that end of the Semidiameter of the Quadrant where the center is, which center is ſhewed by the little round hole bored ouerthwart thorow the midſt of the thickneſſe of the Square Ruler, neere the end thereof; which Ruler we called the Semidiameter of the Quadrant.

This ſight (whenſoeuer it is to be vſed) muſt ſo be put on vpon the end of that Ruler, that the flat ſide thereof (which muſt be ſet towatds the arch of the Quadrant) may diuide the foreſaid round hole euen by the midſt thereof, the ſharpe edge of that ſight ariſing perpendicularly from the very midſt or center of that hole; which is alſo the center of the Quadrant, whē the other end of the Square Ruler or Semidiameter thereof, being put into his ſocket, is thruſt ſo farre forwards, that the end thereof commeth to be euen with the fore-end of the ſocket.

Two ſides of the arch of the Quadrant, that is to ſay, one of the ſtraight or plaine ſides, and the hollow ſide thereof, are diuided into 90 degrees, and euery degree into 6 parts, each part conteining 10 minutes, and vpon the ſtraight ſide of the Quadrant, there be figures ſet to euery fifth degree, and that in two ranks or limbes; the one beginning from that end of the arch, where the ſmall fixed ſight is placed; the

other beginning and proceeding from the other end of the Arch, where the Nocturnall is to be fastened or put on, that so the number of the degrees and minutes might the easelier be reckoned from either end of the Arch, as need shall require.

Chap. XXXVI.

Of the Nocturnall or Night-diall.

THe Nocturnall conteineth 3 circles; that is, the houre circle, the day circle, and the pole-star circle.

The biggest of these circles (which is to be fastened to the end of the Arch of the Quadrant,) I call the houre circle, and it is diuided into 24 houres and halfe houres, with figures set to euery houre, for the easier reckoning of them.

Next within this is the day circle, or circle of daies, because it conteineth the daies of all the moneths of the yeere; which daies are signified by the small diuisions round about, at the circumference of this circle. Euery fifth day hath his stroke drawne a little longer then the rest, that so any day you desire, may the easelier be found. The small diuisions conteine but one day a peece. The lines shewing the beginnings and endings of the moneths, are drawne ouerthwart the whole breadth of this circle. The beginning of Ianuary is knowne by the two lines drawne neere together ouerthwart this circle; whereof one sheweth the end of the moneth of December, and the other sheweth the beginning of Ianuarie,

rie, which is marked with two prickes. February is easilie knowne in this circle, becauſe it hath but onely 28 daies. March is by the little pole-ſtar circle: and ſo all the reſt of the moneths may easily be knowne by their order. Vpon the center of this arch, (which repreſenteth the Pole of the world,) there be two Indices faſtened: the longer of them may be called the Guard-index, whereto a ſhort pin is faſtened vnderneath, which ſerueth to ſet this Index right vpon the place of the middle Guard in the day-circle, by putting it into the ſmall hole that there is made in that circle. The ſhorter Index reaching from the center of the day-circle, vnto the limb or circumference thereof, that is diuided into daies, may be called the Day-index.

This ſmall circle placed betweene the center of the day-circle, and the moneth of March, may not vnfitly be called the Pole-ſtarre circle; becauſe the diſtance of the center thereof, from the center of the day-circle, is anſwerable to the diſtance of the pole-ſtarre from the Pole; which at this time I haue often found by exact obſeruation, not to be more then 2 degrees and 48 minutes.

Chap. XXXVII.

The vſe of the Sea Quadrant: and that firſt in obſeruing the height of the Sun, looking onely by the ſight at the center, to the Horizon at Sea.

TVrne the center of the Quadrant towards the Sunne, ſo as the ſhadow of the vane or ſight placed at the center may fall vpon the hollow

side of the arch of the Quadrant: then looking thorow the little sight fastened in the end of the arch of the Quadrant, lay the vpper edge of the sight placed at the center euen with the Horizon, and at the same instant let one that standeth by, marke diligently vpon what degree and minute of the Quadrant, the edge of the shadow comming from the said edge of the sight, falleth: for that edge of the shadow vpon the hollow side of the arch of the Quadrant, sheweth the height of the vpper edge of the Sunne. From this therefore subtract 16 minutes, and so much also as is answerable to the height of your eye aboue the water (in such sort, as I haue shewed in the vse of the Crosse staffe, in the 15 Chapter of this booke,) and so you shall haue the apparent height of the Sunne aboue the true Horizon.

Chap. XXXVIII.

How with this Quadrant, to obserue the height of the Sunne, with your backe turned towards the Sunne.

SEt the edge of one of the broad moueable sights or vanes euen with that end of the Quadrant where the little sight is fixed. Then looking thorow the slit which is made thorow the midst of the middle sight that is fastened to the double box or socket, turne your backe toward the some, and laying the edge of the vane at the center euen with the Horizon, lift vp, or put downe the arch of the Quadrant, till the vpper edge of the shadow of the broad moueable sight, placed euen with the vpper end of the arch

of

of the Quadrant, agree iustly with the edge of the sight or vane placed at the center. Then reckoning frō the vpper end of the arch of the Quadrāt downwards, see what number of degrees and minutes you finde at the vpper edge or end of the socket, through which the Quadrant moueth, adding alwaies thereto two degrees; for so shall you haue the height of the Sunne (if you abate from hence 16 minutes for the Suns Semidiameter) and the surplussage answerable to the height of the eye aboue the water, as before is shewed in the former Chapter.

Chap. XXXIX.

How to obserue with this Quadrant, the height of the Sun or star, looking both to the Sun or star, & to the Horizon.

SEt the vpper edge of the vppermost moueable sight of the Quadrant at some euen number of degrees, as at 10, 20, or 30, &c. And setting the end of the semidiameter of the Quadrant where the center is to the corner of the eye (as you doe when you obserue with the Crosse-staffe) lay that edge of the sight euen with the vpper edge of the Sunne, and moue the nether moueable sight vp or downe, till the vpper edge thereof lie euen with the Horizon. Then see how many degrees and minutes are conteined betweene the vpper edges of both sights, from which abate as before 16 minutes for the Sunnes semidiameter, and the surplus answerable to the height of your eye aboue the water, so shall you haue the apparent height of the Sunne aboue the true Horizon. But when you obserue the

height of any ſtarres, lay the vpper edge of the vpper ſight, euen with the midſt of the ſtarre, and from the number of degrees and minutes conteined betweene the vpper edges of both ſights, abate onely the ſurplus anſwerable to the height of your eye aboue the water, and ſo you ſhall haue the true height of the ſtarre. But here it muſt be remembred, that before you obſerue the Sunne or ſtarre after this maner, you muſt finde out the eccentricitie of your eye, in ſuch ſort as I haue ſhewed in the 15 Chapter of this booke: which eccentricitie you muſt adde to the diſtance of the center of the Quadrant, from the end of the Semidiameter where you ſet your eye: for ſo much as the ſumme of this diſtance and eccentricitie amounteth vnto, ſo much muſt you thruſt forward the fore-end of the Semidiameter of the Quadrant, beyond the further end of the ſquare ſocket thorow which it is put, that ſo the center of your eye may be brought to the center of the Quadrant.

Chap. XL.

How to finde the height of the Pole, by obſeruation of the Pole-ſtarre and Guard, without giuing or taking any allowance or abatement, at any time when the Pole-ſtarre, the Guard, and Horizon may bee ſeene.

THe long Index of the Nocturnall (which I called the Guard Index) being fixed vpon the place of the middle guard in the day-circle; and the Nocturnall being put vpon the end of

of the arch of the Quadrant, placing also the end of the Semidiameter to your eye, as before, and holding the Quadrant vpright, with the Nocturnall towards the pole-star, till the Diameter of the semicircular hole of the pole-star circle lie (by estimation) æquidistant from the Horizon, both ends of the diameter being leuell, or of like height one with another, and so keeping the pole-star, so neere as you can guesse, vpon the midst of that Diameter, and the fiduciall line of the Guard-index vpon the Guard, moue one of the moueable sights of the Quadrant vp or downe, till the edge thereof lie euen with the Horizon. Thus therefore the pole-star lying vpon the midst of the diameter, (that is, vpon the center of the pole-star circle) and the fiduciall line of the Guard-index vpon the Guard, and the edge of the sight euen with the Horizon; the number of degrees and minutes from the end of the Quadrant (where the Nocturnall is placed) to the edge of the sight, adding thereto fiue degrees, that is, the distance of the center of the Nocturnall from the end of the Quadrant, shall be the height of the Pole; sauing that you must abate (as before) so much as is answerable to the height of your eye aboue the water.

To know the houre of the night by the Nocturnall.

AND the point of the short Index (which wee called the Day-index) being first set to the day of the moneth, sheweth in the houre-circle, the houre of the night, at the time of your obseruation.

SIMON STEVIN his errors, in *blaming me of error in my Tables of Rumbes.*

BEfore I end this Treatiſe, I thinke it meete to ſay ſomething for ſatisfaction of the courteous Reader, concerning ſome faults that *Simon Steuin* of late pretẽdeth to finde in my Table of Rumbes, publiſhed in the former edition of my booke of Errors in Nauigation. For not long ſince, there came forth a great volume of Mathematicall Remembrances, gathered and ſet forth by the ſaid *Steuin*, concerning ſuch points of the Mathematicks; wherein that worthy Generall, Count *Maurice* of Naſſawe, hath for theſe many yeeres ſpent his ſpare houres: whoſe example I wiſh that more of his ranke would follow, for the better inabling them to the diſcharge of their duties. In this volume *Steuin* going about to ſhew diuers waies for the making of the Table of Rumbes, commeth in the ſecond place to that way which I haue already ſhewed in this booke, Chap. 9. pag. 127. which although he acknowledgeth to be moſt eaſie, and findes no fault with the demonſtrated ground thereof; yet he ſaith, my Tables of Rumbs made according to that way, *haue ſome fault in them: but we ſhall, I make no doubt, finde a greater fault in his fault-finding. Though I neuer durſt preſume to imagine I could ſet forth any thing without

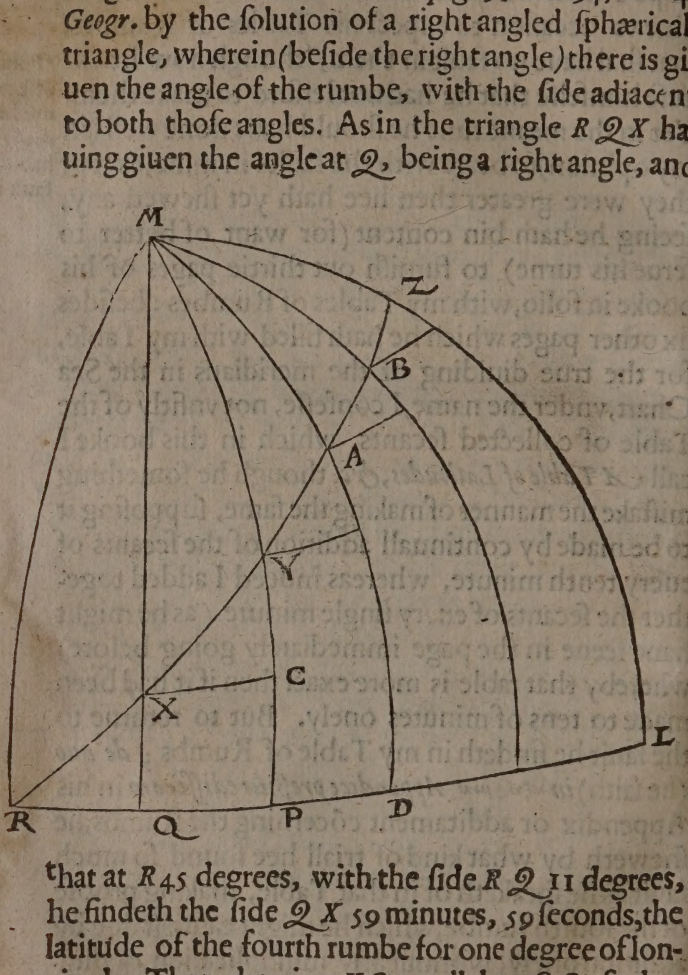
Lib. 4. Geogr. pag. 95.

**Quodam vitio laborant. ſed heus tu, Nulla ne habes vitia? imò haud non fortaſſe minora.*

without some fault. It sufficeth me if the fault be so little, that it cannot sensibly be discerned; which I hope I shall hereafter shew. But *Steuin* doth here giue vs occasion to expect his Tables of Rumbes, that shal haue no fault in them,* though now he excuse himselfe that he had not leisure to make them. Yet in the meane time he should haue done well (in my opinion) to beare with the faults in mine, except they were greater then hee hath yet shewed any, seeing he hath bin content (for want of better to serue his turne) to furnish out thirtie pages of his booke in folio, with my Tables of Rumbes: besides six other pages which he hath filled with my Table, for the true diuiding of the meridians in the Sea Chart, vnder the name, I confesse, not vnfitly of the Table of collected secants, which in this booke I call *A Table of Latitudes, &c.* though he something mistake the manner of making the same, supposing it to be made by continuall addition of the secants of euery tenth minute, whereas indeed I added together the secants of euery single minute (as he might haue seene in the page immediately going before) whereby that table is more exact then if it had been made to tens of minutes onely. But to returne to the fault he findeth in my Table of Rumbs; *de quo* (he saith) *in* κατ' ἐξοχὴν *Appendice pressius edisseram* in his Appendix or additament cõcerning the Rumbs, he sheweth by what kind of triall hee found so much fault as he speaketh of in that Table, making proofe of the fourth rumbe, which he might easilieſt doe by addition onely, without any multiplication or diuision, because there the whole sine and tangent of the rumbs

*For otherwise he should not haue blamed mine for hauing some fault in them.

rumbs angle, (that is, 45 degrees) are æqual, and this trial he maketh according to his first way for the making of the Table of Rumbs, *pag.* 93 and 94, *Lib.* 4. *Geogr.* by the solution of a right angled sphæricall triangle, wherein (beside the right angle) there is giuen the angle of the rumbe, with the side adiacent to both those angles. As in the triangle *R Q X* hauing giuen the angle at *Q*, being a right angle, and



that at *R* 45 degrees, with the side *R Q* 11 degrees, he findeth the side *Q X* 59 minutes, 59 seconds, the latitude of the fourth rumbe for one degree of longitude. Then drawing *X C* parallel to *Q P*, so that *C P* may be æquall to *Q X*, he resolueth in like maner

ner the triangle *Y C X*, supposing the angle at *C* and *X* æquall to those at *Q* and *R*, and the side *X C*, æquall to a degree of the parallel at that latitude 59 minutes, 58 seconds, (but more truely 59 seconds) whereby he findeth the side *C Y* (in like manner as before) 59 minutes, 57 seconds, (but more truely 58 seconds) which added to *P C*, 59 minutes, 59 seconds, shall make *P Y* 1 degree, 59 minutes, 56 seconds, as he saith; but more truely it should be 1 degree, 59 minutes, 57 seconds, the latitude of that rumbe for two degrees of longitude: & thus he proceedeth in al the rest till he come to 78 degrees of longitude, (where he saith) he found the latitude of that rumbe to be 61 degrees, 26 minutes, my table hauing no more but 61 degrees, 14 minutes, and so the difference of latitude arising to no more then 12 minutes for so great a longitude as 78 degrees. And yet he saith, *Certis rationibus cognorat*, he certainely knew that the true latitude must needs be lesse then 61 degrees, 26 minutes, which was to him no small argument, that my table of rumbes came very neere the trueth, though it hit not the naile on the head (as they say). Surely therefore Master *Steuin* might haue eased me of some trouble, and haue saued himselfe some labour & reputation, both if he had spared his paines in seeking to find fault with me for so small a matter, whereby Nauigators could incurre neither damage nor danger, although mine error were so much as he supposeth For (in the practise of Nauigation) what inconueniencie can arise to the Sea-man by such an error as shall cause him to goe wide of his course no more then 12 minutes, in sailing so farre that he must

first

first alter his longitude 78 degrees, and his latitude 61 degrees and more: but the truth is, vpon due triall, (yea euen according to *Steuins* owne way) this error will not be found so much as a minute; and to assure my selfe and others thereof, I tooke the paines to examine throughout the ground of my Table of rumbs, that is, the table of latitudes, or collected secants before set downe, newly calculating the same twice ouer for euery minute, with the helpe of two calculators, alwaies comparing their calculations together, that when any difference chanced betwixt them, they might still finde and amend their fault (if they chanced to make any) before they proceeded any further therein; and by comparing these newly calculated tables with my former, I could not any where finde such difference as could breed any sensible error. Then something to satisfie Master *Steuins* desire (becausse he accounteth not his table of the 8 rumbe taken out of *Appian*, exact enough, shewing onely how many minutes and seconds of a degree of the æquinoctiall, one degree of each parallel conteineth for euery halfe degree of latitude, and that not truely sometimes, as I haue tried: I haue therefore newly and more exactly calculated such a table to minutes, seconds, and thirds, and that for euery 10 minutes of latitude. I made also the like table, to shew how many minutes, seconds, and thirds of one degree of the æquinoctial, answere to 10 minutes of each parallel for euery 10 minutes of latitude. By the first of these tables, I made triall what latitude the fourth rumbe would haue at 78 degrees of longitude, proceeding as *Steuin* did by whole degrees, accor-

cording to his first way of making the table of rumbes, and found the latitude not much aboue a minute lesse then his (*viz.*) 61 degrees, 24 minutes, 44 seconds, which difference might partly arise from the imperfection of the foresaid table of *Appian*, which it seemeth he followed in his calculation. Then by helpe of the second of these tables, I made the like triall for euery 10 minutes of longitude, and so found the latitude of that rumbe at 78 degrees of longitude to be 61 degrees, 15 minutes, 42 seconds, 40 thirds, which also must needes bee greater then the true latitude thereof at that place, by the very same reasons whereby *Steuin* saith, hee knew certainely that the true latitude was lesse then 61 degrees 26 minutes: so then the true latitude of that rumbe for that longitude, must needs be lesse then 61 degrees, 15 minutes, 43 seconds: therefore by *Steuins* owne rule more fitly applied, my table of rumbes accounting that latitude to be no more then 61 degrees 14 minutes, shall not erre so much as two minutes. Yet indeede more exactly it would rather haue been 61 degrees 15 minutes: for to set it downe more scrupulously (according to the way I then followed in making that table) it should be 61 degrees, 14 minutes, 41 seconds. But the trueth is, I did not then purpose, nor care to be so curious, thinking it would be sufficient, if my table of rumbes erred not any where so much as a minute in the latitude of any rumbe; which by this triall already made, I assure my selfe they doe not.

Wherein also I am the more confirmed by the like triall I haue made of the first rumbe (counted

from the meridian) though *Simon Steuin* in his solemne demonstration continued almost in three whole pages in * folio (wherein he professeth that *the scope or marke he aimeth at, is to demonstrate that my table of rumbs is erroneous*) would make the world beleeue that my table erreth aboue two minutes in the latitude of that rumbe, before I come to so little as two degrees of longitude. But the truth is, he much mistaketh the matter, the error being indeede in his owne grosse manner of triall, much more then in my table: for working after his owne way by whole degrees, as he doth, it falleth out euen so as he saith, that the latitude of that rumbe for two degrees of longitude will be aboue 2 minutes greater then my table hath. But if he worke the very same way by sixth parts of degrees, or tennes of minutes, he shall finde but little aboue halfe a minute more then is in my table of rumbes. Nay moreouer, if it shall please him at his leisure to take the paines to make triall hereof to euery single minute, he shall not finde so much as one second more then my account giueth. For following the very same way that he prescribeth for the true making of the table of rumbes in his λογοθεσμία Appendice pag. 154, 155. and so calculating the latitude of the first rumbe for euery single minute of longitude, the latitude of that rumbe for two degrees of longitude, shall be found to be not so much as 10 degrees 0 mi. 14 sec. 46 third. which latitude according to my manner of making my table of rumbes, is not so little as 10 degr. 0 min. 13 sec. 47 third. differing not so much as one second from the former. But according to M. *Steuins* ac-

*Pag. 153. 154. 155.

count

count by whole degrees, it should be 10 degr. 2 min. 6. seconds, exceeding the truth of both the foresaid accounts almost two minutes in latitude, before he be come to so little as two degrees in longitude, and so grossely erring himselfe, whilest he too vnaduisedly, and without iust cause indeuoreth to publish to the world my supposed errors. Which that it may the more manifestly appeare, either to him, or to any other that shall be disposed to make triall, as I haue done, I haue here set downe the particular account hereof in the tables following.

By whole degrees, the first rumbes

Longitude.	Latitude.
De. Mi.	Deg. Mi. Se.
1 0	5 1 38
2 0	10 2 6

By tens of minutes, the first rumbes

Longitude.	Latitude.
De. Mi.	Deg. Mi. Se. Th.
0 10	0 50 16 23
0 20	1 40 32 26
0 30	2 30 47 33
0 40	3 21 1 5
0 50	4 11 12 16
1 0	5 1 20 46
1 10	5 51 25 35
1 20	6 41 26 18
1 30	7 31 22 14
1 40	8 21 12 38
1 50	9 10 57 0
2 0	10 0 34 40

The first table, accounting by whole degrees, as *Steuin* doth, sheweth the latitude of the first rumbe for two degrees of longitude to be tenne degrees, two min. six seconds. Whereas the second table accounting by tennes of minutes, giueth it to be no more thē ten degrees, 0 min. 34. seconds, 40 thirds. And the third by single min. findeth but 10 degrees, 0 min. 14 seconds, 45 thirds, 21 fourths.

By single minutes, the first rumbes						*By single minutes, the first rumbes*					
Lõgitude	*Latitude.*					*Lõgitude*	*Latitude.*				
Deg. Mi.	*Deg. mi. Se. Th. four.*					*Deg. Mi.*	*Deg. mi. Se. Th. four.*				
0 1	0	5	1	38	25	0 31	2	35	47	48	29
0 2	0	10	3	16	50	0 32	2	40	49	8	18
0 3	0	15	4	55	10	0 33	2	45	50	26	56
0 4	0	20	6	33	25	0 34	2	50	51	44	14
0 5	0	25	8	11	30	0 35	2	55	53	0	17
0 6	0	30	9	49	25	0 36	3	0	54	14	59
0 7	0	35	11	27	10	0 37	3	5	55	28	21
0 8	0	40	13	4	40	0 38	3	10	56	40	17
0 9	0	45	14	41	50	0 39	3	15	57	50	48
0 10	0	50	16	18	40	0 40	3	20	58	59	48
0 11	0	55	17	55	10	0 41	3	26	0	7	18
0 12	1	0	19	31	15	0 42	3	31	1	14	3
0 13	1	5	21	6	55	0 43	3	36	2	18	22
0 14	1	10	22	42	4	0 44	3	41	3	21	6
0 15	1	15	24	16	43	0 45	3	46	4	22	9
0 16	1	20	25	50	47	0 46	3	51	5	21	26
0 17	1	25	27	24	15	0 47	3	56	6	19	3
0 18	1	30	28	57	4	0 48	4	1	7	14	49
0 19	1	35	30	29	12	0 49	4	6	8	8	45
0 20	1	40	32	0	40	0 50	4	11	9	0	50
0 21	1	45	33	31	22	0 51	4	16	9	51	0
0 22	1	50	35	1	14	0 52	4	21	10	39	14
0 23	1	55	36	30	16	0 53	4	26	11	25	27
0 24	2	0	37	58	28	0 54	4	31	12	9	39
0 25	2	5	39	25	53	0 55	4	36	12	51	51
0 26	2	10	40	52	14	0 56	4	41	13	31	57
0 27	2	15	42	17	45	0 57	4	46	14	9	53
0 28	2	20	43	42	5	0 58	4	51	14	45	37
0 29	2	25	45	5	20	0 59	4	56	15	19	11
0 30	2	30	46	27	30	1 0	5	1	15	50	29

By single minutes, the first rumbes						*By single minutes, the first rumbes*					
Lõgitude		*Latitude.*				*Lõgitude*		*Latitude.*			
Deg.	*Mi.*	*Deg.*	*mi.*	*Se.*	*Th.* *four.*	*Deg.*	*Mi.*	*Deg.*	*mi.*	*Se.*	*Th.* *four.*
1	1	5	6	16	19 32	1	31	7	36	9	56 9
1	2	5	11	16	46 14	1	32	7	41	8	55 28
1	3	5	16	17	10 35	1	33	7	46	7	51 20
1	4	5	21	17	32 30	1	34	7	51	6	43 41
1	5	5	26	17	52 0	1	35	7	56	5	32 26
1	6	5	31	18	8 59	1	36	8	1	4	17 34
1	7	5	36	18	23 27	1	37	8	6	2	59 7
1	8	5	41	18	35 19	1	38	8	11	1	36 58
1	9	5	46	18	44 40	1	39	8	16	0	11 8
1	10	5	51	18	51 20	1	40	8	20	58	41 32
1	11	5	56	18	55 20	1	41	8	25	57	8 5
1	12	6	1	18	56 38	1	42	8	30	55	30 51
1	13	6	6	18	55 11	1	43	8	35	53	49 46
1	14	6	11	18	50 58	1	44	8	40	52	4 45
1	15	6	16	18	43 54	1	45	8	45	50	15 48
1	16	6	21	18	33 59	1	46	8	50	48	22 54
1	17	6	26	18	21 13	1	47	8	55	46	25 59
1	18	6	31	18	5 31	1	48	9	0	44	25 3
1	19	6	36	17	46 48	1	49	9	5	42	20 1
1	20	6	41	17	25 4	1	50	9	10	40	10 52
1	21	6	46	17	0 9	1	51	9	15	37	57 36
1	22	6	51	16	31 28	1	52	9	20	35	40 9
1	23	6	56	16	0 31	1	53	9	25	33	18 26
1	24	7	1	15	26 23	1	54	9	30	30	52 27
1	25	7	6	14	49 4	1	55	9	35	28	22 11
1	26	7	11	14	8 34	1	56	9	40	25	47 34
1	27	7	16	13	24 48	1	57	9	45	23	8 40
1	28	7	21	12	37 41	1	58	9	50	20	25 20
1	29	7	26	11	47 13	1	59	9	55	17	37 34
1	30	7	31	10	53 24	2	0	10	0	14	45 21

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
0 10	10 0 0	0 0	5 10	9 57 34	0 9
0 20	9 59 59	0 1	5 20	9 57 24	0 10
0 30	9 59 59	0 0	5 30	9 57 14	0 10
0 40	9 59 58	0 1	5 40	9 57 4	0 10
0 50	9 59 56	0 2	5 50	9 56 54	0 10
1 0	9 59 54	0 2	6 0	9 56 43	0 11
1 10	9 59 52	0 2	6 10	9 56 32	0 11
1 20	9 59 50	0 2	6 20	9 56 20	0 12
1 30	9 59 48	0 2	6 30	9 56 9	0 11
1 40	9 59 45	0 3	6 40	9 55 57	0 12
1 50	9 59 41	0 4	6 50	9 55 44	0 13
2 0	9 59 38	0 3	7 0	9 55 32	0 12
2 10	9 59 34	0 4	7 10	9 55 19	0 13
2 20	9 59 30	0 4	7 20	9 55 6	0 13
2 30	9 59 26	0 4	7 30	9 54 52	0 14
2 40	9 59 21	0 5	7 40	9 54 38	0 14
2 50	9 59 16	0 5	7 50	9 54 24	0 14
3 0	9 59 11	0 5	8 0	9 54 10	0 14
3 10	9 59 5	0 6	8 10	9 53 55	0 15
3 20	9 58 59	0 6	8 20	9 53 40	0 15
3 30	9 58 53	0 6	8 30	9 53 25	0 15
3 40	9 58 46	0 7	8 40	9 53 9	0 16
3 50	9 58 40	0 6	8 50	9 52 53	0 16
4 0	9 58 32	0 8	9 0	9 52 37	0 16
4 10	9 58 26	0 6	9 10	9 52 20	0 17
4 20	9 58 17	0 9	9 20	9 52 3	0 17
4 30	9 58 9	0 8	9 30	9 51 46	0 17
4 40	9 58 1	0 8	9 40	9 51 29	0 17
4 50	9 57 52	0 9	9 50	9 51 11	0 18
5 0	9 57 43	0 9	10 0	9 50 53	0 18

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
10 10	9 50 35	0 18	15 10	9 39 6	0 27
10 20	9 50 16	0 19	15 20	9 38 39	0 27
10 30	9 49 57	0 19	15 30	9 38 11	0 28
10 40	9 49 37	0 19	15 40	9 37 43	0 28
10 50	9 49 18	0 20	15 50	9 37 14	0 29
11 0	9 48 59	0 19	16 0	9 36 46	0 28
11 10	9 48 39	0 20	16 10	9 36 16	0 30
11 20	9 48 18	0 21	16 20	9 35 47	0 29
11 30	9 47 57	0 21	16 30	9 35 18	0 29
11 40	9 47 36	0 22	16 40	9 34 48	0 30
11 50	9 47 15	0 21	16 50	9 34 17	0 31
12 0	9 46 53	0 22	17 0	9 33 47	0 30
12 10	9 46 31	0 22	17 10	9 33 16	0 31
12 20	9 46 9	0 22	17 20	9 32 45	0 31
12 30	9 45 47	0 22	17 30	9 32 14	0 31
12 40	9 45 24	0 23	17 40	9 31 42	0 32
12 50	9 45 1	0 23	17 50	9 31 9	0 33
13 0	9 44 37	0 24	18 0	9 30 38	0 31
13 10	9 44 14	0 23	18 10	9 30 4	0 34
13 20	9 43 50	0 24	18 20	9 29 33	0 31
13 30	9 43 25	0 25	18 30	9 29 0	0 33
13 40	9 43 1	0 24	18 40	9 28 26	0 34
13 50	9 42 36	0 25	18 50	9 27 53	0 33
14 0	9 42 11	0 25	19 0	9 27 19	0 34
14 10	9 41 45	0 26	19 10	9 26 45	0 34
14 20	9 41 19	0 26	19 20	9 26 10	0 35
14 30	9 40 53	0 26	19 30	9 25 35	0 35
14 40	9 40 27	1 26	19 40	9 25 0	0 35
14 50	9 40 0	1 27	19 50	9 24 25	0 35
15 0	9 39 33	0 27	20 0	9 23 49	0 36

A Table of the eigth rumbe.

Latitude.	*Ten min. of longitude.*	*Difference.*	*Latitude.*	*Ten min. of longitude.*	*Difference.*
De. Mi.	*min. sec. thir.*	*sec. thir.*	*De. Mi.*	*min. sec. thir.*	*sec. thir.*
20 10	9 23 13	0 36	25 10	9 3 3	0 44
20 20	9 22 37	0 36	25 20	9 2 18	0 45
20 30	9 22 0	0 37	25 30	9 1 33	0 45
20 40	9 21 23	0 37	25 40	9 0 48	0 45
20 50	9 20 46	0 37	25 50	9 0 2	0 46
21 0	9 20 9	0 37	26 0	8 59 17	0 45
21 10	9 19 31	0 38	26 10	8 58 31	0 46
21 20	9 18 53	0 38	26 20	8 57 44	0 47
21 30	9 18 15	0 38	26 30	8 56 58	0 46
21 40	9 17 37	0 38	26 40	8 56 11	0 47
21 50	9 16 58	0 39	26 50	8 55 24	0 47
22 0	9 16 19	0 39	27 0	8 54 36	0 48
22 10	9 15 39	0 40	27 10	8 53 49	0 47
22 20	9 15 0	0 39	27 20	8 53 1	0 48
22 30	9 14 20	0 40	27 30	8 52 12	0 49
22 40	9 13 40	0 40	27 40	8 51 24	0 48
22 50	9 12 59	0 41	27 50	8 50 35	0 49
23 0	9 12 18	0 41	28 0	8 49 46	0 49
23 10	9 11 37	0 41	28 10	8 48 57	0 49
23 20	9 10 56	0 41	28 20	8 48 7	0 50
23 30	9 10 14	0 42	28 30	8 47 17	0 50
23 40	9 9 32	0 42	28 40	8 46 27	0 50
23 50	9 8 50	0 42	28 50	8 45 37	0 50
24 0	9 8 8	0 42	29 0	8 44 46	0 51
24 10	9 7 25	0 43	29 10	8 43 55	0 51
24 20	9 6 42	0 43	29 20	8 43 4	0 51
24 30	9 5 59	0 43	29 30	8 42 13	0 51
24 40	9 5 15	0 44	29 40	8 41 21	0 52
24 50	9 4 31	0 44	29 50	8 40 29	0 52
25 0	9 3 47	0 44	30 0	8 39 37	0 52

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
30 10	8 38 44	0 53	35 10	8 10 29	1 1
30 20	8 37 52	0 52	35 20	8 9 29	1 0
30 30	8 36 59	0 53	35 30	8 8 28	1 1
30 40	8 36 5	0 54	35 40	8 7 27	1 1
30 50	8 35 12	0 53	35 50	8 6 26	1 1
31 0	8 34 18	0 54	36 0	8 5 25	1 1
31 10	8 33 24	0 54	36 10	8 4 23	1 2
31 20	8 32 30	0 54	36 20	8 3 21	1 2
31 30	8 31 35	0 55	36 30	8 2 19	1 3
31 40	8 30 40	0 55	36 49	8 1 17	1 2
31 50	8 29 45	0 55	36 50	8 0 14	1 3
32 0	8 28 50	0 55	37 0	7 59 11	1 3
32 10	8 27 54	0 56	37 10	7 58 8	1 3
32 20	8 26 58	0 56	37 20	7 57 4	1 4
32 30	8 26 2	0 56	37 30	7 56 1	1 3
32 40	8 25 6	0 56	37 40	7 54 57	1 4
32 50	8 24 9	0 57	37 50	7 53 53	1 4
33 0	8 23 12	0 57	38 0	7 52 48	1 5
33 10	8 22 15	0 57	38 10	7 51 44	1 4
33 20	8 21 18	0 57	38 20	7 50 39	1 5
33 30	8 20 20	0 58	38 30	7 49 34	1 5
33 40	8 19 22	0 58	38 40	7 48 29	1 5
33 50	8 18 24	0 58	38 50	7 47 23	1 6
34 0	8 17 25	0 59	39 0	7 46 17	1 6
34 10	8 16 27	0 58	39 10	7 45 11	1 6
34 20	8 15 28	0 59	39 20	7 44 5	1 6
34 30	8 14 29	0 59	39 30	7 42 59	1 6
34 40	8 13 29	1 0	39 40	7 41 52	1 7
34 50	8 12 29	1 0	39 50	7 40 45	1 7
35 0	8 11 30	0 59	40 0	7 39 38	1 7

A Table of the eigth rumbe.

Latitude.	*Ten min. of longitude.*	*Difference.*	*Lattitude.*	*Ten min. of longitude.*	*Difference.*
De. Mi	*min. sec. thir.*	*sec. thir.*	*De. Mi.*	*min. sec. thir.*	*sec. thir.*
40 10	7 38 30	1 8	45 10	7 3 2	1 14
40 20	7 37 23	1 7	45 20	7 1 47	1 15
40 30	7 36 15	1 8	45 30	7 0 33	1 14
40 40	7 35 7	1 8	45 40	6 59 18	1 15
40 50	7 33 58	1 9	45 50	6 58 3	1 15
41 0	7 32 48	1 10	46 0	6 56 48	1 15
41 10	7 31 41	1 7	46 10	6 55 32	1 16
41 20	7 30 32	1 9	46 20	6 54 17	1 15
41 30	7 29 22	1 10	46 30	6 53 1	1 16
41 40	7 28 13	1 9	46 40	6 51 45	1 16
41 50	7 27 3	1 10	46 50	6 50 29	1 16
42 0	7 25 53	1 10	47 0	6 49 12	1 17
42 10	7 24 43	1 10	47 10	6 47 55	1 17
42 20	7 23 33	1 10	47 20	6 46 38	1 17
42 30	7 22 22	1 11	47 30	6 45 21	1 17
42 40	7 21 11	1 11	47 40	6 44 4	1 17
42 50	7 20 0	1 11	47 50	6 42 47	1 17
43 0	7 18 49	1 11	48 0	6 41 29	1 18
43 10	7 17 37	1 12	48 10	6 40 11	1 18
43 20	7 16 26	1 11	48 20	6 38 53	1 18
43 30	7 15 14	1 12	48 30	6 37 34	1 19
43 40	7 14 1	1 13	48 40	6 36 16	1 18
43 50	7 12 49	1 12	48 50	6 34 57	1 19
44 0	7 11 36	1 13	49 0	6 33 38	1 19
44 10	7 10 23	1 13	49 10	6 32 19	1 19
44 20	7 9 10	1 13	49 20	6 31 0	1 19
44 30	7 7 57	1 13	49 30	6 29 40	1 20
44 40	7 6 44	1 13	49 40	6 28 20	1 20
44 50	7 5 30	1 14	49 50	6 27 1	1 19
45 0	7 4 16	1 14	50 0	6 25 40	1 21

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
50 10	6 24 20	1 20	55 10	5 42 43	1 26
50 20	6 23 0	1 20	55 20	5 41 17	1 26
50 30	6 21 39	1 21	55 30	5 39 51	1 26
50 40	6 20 18	1 21	55 40	5 38 24	1 27
50 50	6 18 57	1 21	55 50	5 36 58	1 26
51 0	6 17 36	1 21	56 0	5 35 31	1 27
51 10	6 16 14	1 22	56 10	5 34 4	1 27
51 20	6 14 52	1 22	56 20	5 32 37	1 27
51 30	6 13 31	1 21	56 30	5 31 10	1 27
51 40	6 12 9	1 22	56 40	5 29 42	1 28
51 50	6 10 46	1 23	56 50	5 28 15	1 27
52 0	6 9 24	1 22	57 0	5 26 47	1 28
52 10	6 8 1	1 23	57 10	5 25 16	1 28
52 20	6 6 38	1 23	57 20	5 23 51	1 28
52 30	6 5 15	1 23	57 30	5 22 23	1 28
52 40	6 3 52	1 23	57 40	5 20 54	1 29
52 50	6 2 29	1 23	57 50	5 19 26	1 28
53 0	6 1 5	1 24	58 0	5 17 57	1 29
53 10	5 59 42	1 23	58 10	5 16 28	1 29
53 20	5 58 18	1 24	58 20	5 14 59	1 29
53 30	5 56 54	1 24	58 30	5 13 30	1 29
53 40	5 55 29	1 25	58 40	5 12 1	1 29
53 50	5 54 5	1 24	58 50	5 10 31	1 30
54 0	5 52 40	1 25	59 0	5 9 1	1 30
54 10	5 51 16	1 24	59 10	5 7 5	1 29
54 20	5 49 51	1 25	59 20	5 6 2	1 30
54 30	5 48 25	1 26	59 30	5 4 31	1 31
54 40	5 47 0	1 25	59 40	5 3 1	1 30
54 50	5 45 35	1 25	59 50	5 1 31	1 30
55 0	5 44 9	1 26	60 0	5 0 0	1 31

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
60 10	4 58 29	1 31	65 10	4 11 59	1 35
60 20	4 56 58	1 31	65 20	4 10 24	1 35
60 30	4 55 22	1 31	65 30	4 8 49	1 35
60 40	4 53 56	1 31	65 40	4 7 17	1 35
60 50	4 52 25	1 31	65 50	4 5 38	1 35
61 0	4 50 53	1 32	66 0	4 4 3	1 35
61 10	4 49 22	1 31	66 10	4 2 27	1 36
61 20	4 47 50	1 32	66 20	4 0 51	1 36
61 30	4 46 18	1 32	66 30	3 59 15	1 36
61 40	4 44 46	1 32	66 40	3 57 39	1 36
61 50	4 43 13	1 33	66 50	3 56 3	1 36
62 0	4 41 41	1 32	67 0	3 54 26	1 37
62 10	4 40 9	1 32	67 10	3 52 50	1 36
62 20	4 38 36	1 33	67 20	3 51 53	1 37
62 30	4 37 3	1 33	67 30	3 49 37	1 36
62 40	4 35 30	1 33	67 40	3 48 0	1 37
62 50	4 33 57	1 33	67 50	3 46 23	1 37
63 0	4 32 42	1 33	68 0	3 44 46	1 37
63 10	4 30 50	1 34	68 10	3 43 9	1 37
63 20	4 29 17	1 33	68 20	3 41 32	1 37
63 30	4 27 43	1 34	68 30	3 39 44	1 38
63 40	4 26 9	1 34	68 40	3 38 17	1 37
63 50	4 24 36	1 33	68 50	3 36 39	1 38
64 0	4 23 1	1 35	69 0	3 35 1	1 37
64 10	4 21 27	1 34	69 10	3 33 24	1 38
64 20	4 19 53	1 34	69 20	3 31 46	1 38
64 30	4 18 18	1 35	69 30	3 30 8	1 38
64 40	4 16 44	1 34	69 40	3 28 9	1 39
64 50	4 15 9	1 35	69 50	3 26 51	1 38
65 0	4 13 14	1 35	70 0	3 25 13	1 38

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
70 10	3 23 14	1 39	75 10	2 33 36	1 42
70 20	3 21 56	1 38	75 20	2 31 59	1 41
70 30	3 20 17	1 39	75 30	2 30 14	1 41
70 40	3 18 38	1 39	75 40	2 28 32	1 42
70 50	3 16 59	1 39	75 50	2 26 51	1 41
71 0	3 15 21	1 38	76 0	2 25 9	1 42
71 10	3 13 41	1 40	76 10	2 23 28	1 41
71 20	3 12 00	1 38	76 20	2 21 46	1 42
71 30	3 10 23	1 40	76 30	2 20 14	1 42
71 40	3 8 44	1 39	76 40	2 18 22	1 42
71 50	3 7 4	1 40	76 50	2 16 50	1 42
72 0	3 5 25	1 39	77 0	2 14 58	1 42
72 10	3 3 45	1 40	77 10	2 13 16	1 42
72 20	3 2 5	1 40	77 20	2 11 34	1 42
72 30	3 0 25	1 40	77 30	2 9 52	1 42
72 40	2 58 46	1 39	77 40	2 8 10	1 42
72 50	2 57 6	1 40	77 50	2 6 27	1 43
73 0	2 55 25	1 41	78 0	2 4 45	1 42
73 10	2 53 45	1 40	78 10	2 3 2	1 43
73 20	2 52 5	1 40	78 20	2 1 20	1 42
73 30	2 50 25	1 40	78 30	1 59 37	1 43
73 40	2 48 44	1 41	78 40	1 57 55	1 42
73 50	2 47 4	1 40	78 50	1 56 12	1 43
74 0	2 45 23	1 41	79 0	1 54 29	1 43
74 10	2 43 42	1 41	79 10	1 52 46	1 43
74 20	2 42 2	1 40	79 20	1 51 3	1 43
74 30	2 40 20	1 42	79 30	1 49 21	1 42
74 40	2 38 40	1 40	79 40	1 47 38	1 43
74 50	2 36 59	1 41	79 50	1 45 55	1 43
75 0	2 35 18	1 41	80 10	1 44 11	1 44

A Table of the eigth rumbe.

Latitude.	*Ten min. of longitude.*	*Difference.*	*Latitude.*	*Ten min. of longitude.*	*Difference.*
De. Mi.	*min. sec. thir.*	*sec. thir.*	*De. Mi.*	*min. sec. thir.*	*sec. thir.*
80 10	1 42 28	1 43	85 10	0 50 33	1 45
80 20	1 40 45	1 43	85 20	0 48 49	1 44
80 30	1 39 0	1 43	85 30	0 47 5	1 44
80 40	1 37 18	1 44	85 40	0 45 20	1 45
80 50	1 35 35	1 44	85 50	0 43 36	1 44
81 0	1 33 52	1 43	86 0	0 41 51	1 45
81 10	1 32 8	1 44	86 10	0 40 7	1 44
81 20	1 30 25	1 43	86 20	0 38 22	1 45
81 30	1 28 41	1 44	86 30	0 36 38	1 44
81 40	1 26 58	1 43	86 40	0 34 53	1 45
81 50	1 25 14	1 44	86 50	0 33 9	1 44
82 0	1 23 40	1 44	87 0	0 31 24	1 45
82 10	1 21 57	1 43	87 10	0 29 40	1 44
82 20	1 20 3	1 44	87 20	0 27 55	1 45
82 30	1 18 19	1 44	87 30	0 26 10	1 45
82 40	1 16 35	1 44	87 40	0 24 26	1 44
82 50	1 14 51	1 44	87 50	0 22 41	1 45
83 0	1 13 7	1 44	88 0	0 20 56	1 45
83 10	1 11 23	1 44	88 10	0 19 12	1 44
83 20	1 9 39	1 44	88 20	0 17 27	1 45
83 30	1 7 55	1 44	88 30	0 15 42	1 45
83 40	1 6 11	1 44	88 40	0 13 58	1 44
83 50	1 4 27	1 44	88 50	0 12 13	1 45
84 0	1 2 43	1 44	89 0	0 10 28	1 45
84 10	1 0 59	1 44	89 10	0 9 44	1 44
84 20	0 59 15	1 44	89 20	0 6 59	1 45
84 30	0 57 31	1 44	89 30	0 5 14	1 45
84 40	0 55 46	1 44	89 40	0 3 29	1 45
84 50	0 54 2	1 44	89 50	0 1 45	1 44
85 0	0 52 18	1 44	90 0	0 0 0	

This table of the eigth rumbe, shewing the quantitie of 10 minutes of longitude at euery 10 minutes of latitude, in minutes, seconds, and thirds of one degree of the æquinoctial, I thought good here to adioyne for their sakes that may peraduenture be desirous by themselues to make triall of that I haue before written, concerning the grosse and rude manner of examination, which *Simon Steuin* vseth to make the world beleeue that my table of rumbes is so much erroneous as he saith, and after his fashion would seeme to demonstrate. And lest any should suspect that this table also may be as faultie as *Steuin* would perswade vs the other is, I haue thought good here to shew the way how I made the same, that if any list take so much paines, he may either examine and correct this if neede shall be, or make a new one if he will, which may be done after this manner, and by this rule: What proportion the whole sine hath to the sine of the latitudes complement; the same proportion hath one sixth part of a degree of the æquinoctiall, that is, 10 minutes, which make 36000 thirds, to the number of the same thirds of a degree of the æquinoctiall, contained in 10 minutes of longitude at the same latitude, which being diuided by 60, the remainder shall be the thirds remaining besides minutes and seconds, and this first quotient being againe diuided by 60, the second quotient shall bee the minutes, and the remainder thereof the seconds. For example, suppose you would finde the quantitie of 10 minutes of a degree in the parallell, whose latitude is 10 degrees; now the complement of this latitude is 80 degrees, the sine whereof

is

is 9848,078, the whole sine being 10,000,000: and as this whole sine is to the sine aforesaid, so is 36,000 (that is, the number of thirds that are in ten minutes of the æquinoctiall) to 35,453, that is, the number of the same thirds contained in ten min. of a degree of the said parallel. And these thirds diuided by 60, giue in the quotient 590 sec. and 53 thirds remaining; and 590 diuided again by 60, the quotient is 9 min. and the remainder 50 seconds. So then, the quantitie of ten min. of longitude at ten degr. of latitude, shall be 9 min. 50 sec. 53 thirds of one degree of the æquinoctial. And thus was made the whole table.

The making of the table of Rumbes.

Now by help of this table of the eigth rumbe, the preceding table of the first rumb next the meridian, and all the rest may thus be made: As the whole sine, is to the tangent of the rumbes angle with the æquinoctiall; so is one minute of the æquinoctiall to the latitude of the same rumbe for one minute of longitude. And so is a minute of longitude (found out by this table of the eigth rumbe) at that latitude, to the difference of latitude; which added to the former latitude, giueth the latitude of ỹ same rumb, for two minutes of longitude: and againe at this latitude, a minute of longitude (found by the same table) shall haue the same proportion to the difference of latitude; which added to the latitude of the same rumb for two minutes of longitude, sheweth the latitude of that rumbe for three minutes of longitude. And after this manner proceeding in all the rest, you may make vp ỹ whole table of rumbs.

FINIS.

THE DIVISION OF THE WHOLE

Art of Nauigation.

THE whole Art of Nauigation, which teacheth vs to saile by courses and by heights, is diuided into two principall parts; the Theoricke, and the Practicke. The Theoricke teacheth the composition of the Sphære of the world in generall; and in particular informeth vs of the number, figure, and motions of the heauens, especially of the highest moueable heauen, called Primum Mobile, and of the ninth, eighth, fourth, and first heauen: also it sheweth vs the quantitie and situation of the elements, and principally of the earth and water; and the circles which are imagined to be in that Sphære; without the knowledge of which, it is impossible to be a Nauigator. The Practicke part teacheth the making and vse of those instruments which are vsed in Nauigation, as namely the Astrolabe, the Crosse-staffe, the Sea-compasse, and the Diall, with the Regiment of the Sunne, and of the starre, the rules of the Moone, and of the tides, the declaration of the Sea-Chart, and other things appertaining hereunto.

Chap. I.
The definition of the Sphære.

A Sphære is a ſolide or maſſie body, without hollownes, & perfectly round; in the midſt whereof there is a pricke called the center, by which there paſſeth a right line named the axtree, and the points where this line endeth vpon the ſuperficies of the whole body are called poles, becauſe vpon them the Sphære is moued.

Chap. II.
That the whole world is a Sphære.

And ſo it is euident that the whole frame of the world wherein we liue, is a Sphære; being as it is ſolide, ſo that in the whole world there is no emptie place: alſo it is perfectly round vpon the vpper ſuperficies of the higheſt heauen: and it hath in the very midſt a certeine point, to wit, the center of the earth, by which we doe imagine a right line or axtree, to paſſe from one poſe to another, vpon which the world is moued about from eaſt to weſt.

Chap. III.
Of the diuiſion of the Sphære.

The whole Sphære of the world is diuided into two parts or regions; the elementar, and celeſtiall. The elementar part or region hath foure parts: the firſt whereof is the earth, which

toge-

together with the element of water (which is the second) maketh one perfect Globe:

A figure wherein may be seene the composition of the whole Sphære of the world.

and round about both these are two other elements, namely the aire, and aboue that the fire, which filleth the space betweene the aire and the Sphære of the Moone: of which elements (by vertue of the heate of the heauens,) are made and compounded all corruptible things in the world.

The celestiall region consisteth of other ten parts: the first whereof is the sphære of the Moone; the second, the sphære of *Mercury*; the third, of *Venus*; the fourth, is the sphære of the Sunne; the fift, of *Mars*; the sixt, of *Iupiter*; the seuenth, of *Saturne*; the eight, is the sphære of the fixed starres, which is called the firmament; the ninth is the Crystalline heauen; and lastly, the tenth and highest is the sphære called the Primum mobile, that is, the first or highest moueable heauen. That which remaineth, called the Empyreall heauen, because it hath no motion, commeth not to be considered on in the Art of Nauigation.

Chap. IIII.

Of the motion of the heauens.

THe number of the heauens is knowne by the motions obserued in them, which are ten, distinct one from another. For the Moone moueth her proper and peculiar motion in 27 daies, and eight houres, which is one reuolution: *Mercury*, *Venus*, and the Sun finish their motion in one yeere, which conteineth 365 daies, and almost a quarter of a day: *Mars* runneth his course in two yeeres; *Iupiter* in twelue yeeres; *Saturne* in thirtie yeeres; the eight sphære (according to the opinion of some) in seuen thousand

thousand yeeres; the ninth, in fiue and twenty thousand, & eight hundred yeeres; and the tenth, in foure and twenty houres almost. Which ten motions are reduced vnto three principall: the first is that of the first moueable vpon the two ends of the axeltree, which are called the poles of the world, from East to West, turning about againe vnto the East in 24 houres: and this Sphære, by the force of his motiō, carieth about with it all the other lower Sphæres in the space of 24 houres. Howbeit they moue also the contrary way with a second motion, which is from west to east, vpō two other poles distant frō the first, about three and twenty and one halfe, such parts whereof the whole compasse of heauen conteineth three hundred and sixtie. And this second motion is accomplished in each of the lower heauens, in diuers spaces of time, as is before said. The third motion is proper to the eighth heauen, wherein the fixed starres are placed; which motion is the cause that the distance of the poles of the first motion, from them of the second motion doth varie, being sometimes greater, and sometimes lesse.

Chap. V.

Of the figure of the heauens.

THat the heauens are round, it is proued; because roundnesse is the most perfect figure of all others, being whole and entire, hauing no need of any ioints, being also of the greatest capacitie of all figures that haue the same compasse, and in that respect most fit to conteine all other

things. Also the principall bodies of the world, as the Sunne, the Moone, and the starres, are of this figure; and we see the same likewise in those things which are bounded by themselues; as it is manifest in drops of water, and all other liquid things.

Chap. VI.

That the earth and water make one perfect Globe.

THere is nothing that sheweth more cleerely that the earth and water make one round Globe, then the shadow which they make in the eclipses of the Moone: which shadow we alwaies see to be a part of a circle. For if the body, which is the cause of the same shadow, were three-square, or foure-square, the shadow it selfe also would appeare in the same fashion. Wherefore the shadow of these two bodies together, being round, it is manifest that they are round also.

Chap. VII.

That the earth is in the center of the world.

ONe signe wee haue to be assured that the earth is in the midst and center of the world; namely, that whersoeuer we are vpon the face of the earth, we alwaies see one halfe of the heauens, the other halfe being hiddden out of our sight. Moreouer, the stars (in what part of the heauens soeuer they be, either in the east, west, or south, we see that they are alwaies of the very same bignes. Wher-

by

by we may easily perceiue, that they are alwaies æqually distant from our sight: and whereas they moue round about it, it followeth that we are vpon the center of that body, on whose superficies the said starres describe their circles.

Chap. VIII.

The whole quantitie of the earth.

AND albeit the Globe of the earth and water, compared with the sphæres of the starres, is as it were a center or prick; yet being considered by it selfe, it conteineth in the greatest circle thereof 6300 common Spanish leagues. Which a man may easilie perceiue, by taking two such points or head-lands of the earth, as are vnder the same meridian, and which differ in distance one from another so much as one of those parts is, whereof the compasse of the whole world conteineth 360; and it is found both by nauigation at Sea, and also by trauell on land, that the two foresaid points are distant each from other 17 leagues and $\frac{1}{7}$: of which leagues, each one conteineth 4000 pases, euery pase 5 foote, euery foote 16 fingers, and euery finger 4 graines of barley.

Chap. IX.

Of the Æquinoctiall circle.

BEing to treat of the circles of the sphære of the world, the first which offreth it selfe to be spoke of, is the æquinoctiall circle; by means whereof, we doe know in what part of the world we are:

and in it, in the Sea Chart are placed all these points or degrees of longitude; and from it the latitudes are accounted. So that the æquinoctiall is a circle which diuideth the world into two æquall portions, and is æqually distant euery where from either of the poles. And it is called the æquinoctiall circle, because that when the Sunne passeth vnder it, vpon the 11 of March, and the 13 of September, it maketh the day æquall to the night. The knowledge of this circle in the Art of Nauigation, doth helpe vs to finde the latitude or distance from the line: and from this circle are reckoned the declinations of the Sunne in the regiment thereof. And alwaies those Charts of Nauigation which are either vniuersall, or halfe vniuersall, haue this æquinoctiall circle, drawne with a great red line, which passeth by the beginning of the account of the degrees of latitude.

Chap. X.

Of the Poles of the world.

AND here it is to be noted, that one of those two Poles, (from which the æquinoctiall is æqually distant) which is alwaies in our sight, (becauſe it is continually aboue our Horizon) is called the pole arcticke, the septentrionall, or north pole. But the other opposite pole (which we neuer see, becauſe it is vnder our Horizon) is called the pole antarcticke, and the meridionall, or south pole. And so that part of the world which is betweene the æquinoctiall and the north pole, is called the North

part

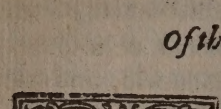
part: and that which is from the æquinoctiall to the south pole, is called the South part.

Chap. XI.
Of the Ecliptick line.

THe æquinoctiall circle is diuided into two æquall parts by another circle called the ecliptick, whereof one halfe is betweene the æquinoctiall and the north pole, and the other halfe betweene the æquinoctiall and the south pole. And that part thereof which is furtheſt distant from the æquinoctiall, is distant from the same about 23 degrees and a halfe. And because the Sun moueth in this circle without departing from it, hereof proceed the declinatiõs thereof. And this circle in all parts is æqually distant from the poles of the second motion, which are called the poles of the ecliptick. And through this circle the Sunne is continually moued by his proper motion from east to west: by means of which motion sometimes he passeth vnder the æquinoctiall, and at other times departeth from it, both towards the north, and towards the south: and the quantitie of his greateſt distance is about 23 degrees, and $\frac{1}{2}$: and so much is the distance of the poles of the eclipticke, from the poles of the æquinoctiall. And albeit this circle is not drawne in the Sea Chart, yet is it in some sort represented in the tables of the Sunnes declination, which are gathered from the motion, which the Sun maketh vnder the Eclipticke.

Chap.

Chap. XII.
Of the declination of the Sunne.



THe motion of the Sunne vnder the eclipticke, is the cause of his declination: which is nothing else but the daily swaruing or declining of the Sunne from the æquinoctiall line. And this declination when the Sunne is vnder the æquinoctial, vpon the ~~one and twentieth~~ 22. of March, and ~~three and twentieth~~ 23. of September, is nothing at all: so likewise vpon the ~~two and twentieth~~ 22. of Iune, and ~~two and twentieth~~ 22. of December, the declination is at the greatest. And albeit this greatest declination be now in our time about three and twenty degrees and an halfe; yet hath it at other times been found otherwise, by reason of a third motion proper to the eighth heauen: but it alwaies keepeth betweene 23. degrees, 28 minutes; and 23 degrees, 52 minutes. From hence therefore we doe infer, that at diuers times it is meet to make new and diuers tables of the declination of the Sunne.

Chap. XIII.
Of the Colures.

THere are two circles of the Sphære, either of which diuideth it into two æquall parts: and they are called Colures, because that in the reuolution which they make, by force of the Pri-

Primum mobile, they doe not shew themselues wholly vnto vs; so as wee may see all parts of them. One of them is called the Æquinoctiall colure, because it passeth by the poles of the world, and the points where the eclipticke cutteth the æquinoctiall; and when the Sunne by his owne proper motion commeth vnto it, hee maketh the day and the night æquall, and diuideth the winter from the Spring by the one part; and by the other, summer from Autumne; at which times the Sunne hath no declination at all. The other is called the Solstitiall colure, because it passeth by the poles of the world and of the ecliptick, and by the points where the eclipticke is furthest distant from the æquinoctiall. And when the Sunne by his proper motion commeth vnto it, in the one part it maketh the longest day, and the shortest night, and diuideth the Spring from the Summer, and hath his greatest declination towards the north: and being in the other part, the Sunne maketh the longest night, and shortest day, and diuideth winter from Autumne, and is in his greatest southerly declination. These two colures are noted in the table of the Suns declination: because the æquinoctiall colure passeth by the two points where there is no declination at all, because the Sun is vnder the very æquinoctiall circle: and the solstitiall colure passeth by that place where the Sun hath his greatest declination, which is in 23 degrees and an halfe, or thereabouts.

CHAP.

Chap. XIV.
Of the Meridian circle.

THe Meridian is a circle drawne by the poles of the world (which are all one with the poles of the æquinoctiall) and by the point directly ouer our heads, called the Zenith. And it is called the Meridian, becauſe that when the Sunne by the motion of the Primum mobile commeth vnto this circle, it maketh mid-day, and then he hath been running his courſe from his riſing, till he come thither; iuſt ſo long time as he ſhall be running from thence to the place of his ſetting. The Zenith is a point in the firmament placed directly ouer our heads. And it is to be noted, that when the Sunne is in that circle, it hath the greateſt altitude aboue our Horizon, that it can poſſibly haue the ſame day: by this, and the declination, we come to know how farre we are diſtant from the æquinoctiall, either towards the north, or towards the ſouth. And hence it is that the height of the Sunne in Nauigation is vnderſtood only for that height which the Sunne hath when he is in this circle. And ſo the height of the Sunne ſhall be that part of the meridian which is conteined betweene the Sunne and our Horizon. This circle in the Sea Chart is repreſented by all thoſe lines which are drawne from north to ſouth.

CHAP. XIV.
Of the Horizon.

THe Horizon is a circle which diuideth that part of the heauens which we see, from the residue which we do not see: and it is properly that circle by which, according to our sight, the heauen seemeth to be ioined with the water, when we are at Sea, without sight of any land. This Horizon is of two sorts, namely, right, and oblique. The right Horizon is that which they haue that liue vnder the æquinoctiall, which passeth by their Zenith; and therefore the æquinoctiall line or circle falleth perpendicularly and right acrosse with their Horizon, and both the south and the north poles are in their Horizon. The oblique Horizon is that which they haue that liue not directly vnder the æquinoctiall; for vnto them the æquinoctiall diuideth the Horizon obliquely, and not right acrosse: and one pole is alwaies aboue their Horizon, and the other is beneath their Horizon, and cannot be seene. This Horizon is represented in the Sea-Chart by a certaine imagined circle, whose center is the point where our ship is. From which center are imagined to proceed vnto the said circle 32 lines, which represent the 32 windes or rumbs; which alwaies are drawne in our Sea-Compasse: which likewise in a little peece of paper doth continually represent vnto vs both by day and by night, the whole Horizon with his 32 diuisions.

Chap. XVI.
Of the 32 windes.

THis right or oblique Horizon is diuided into 32 æquall parts, by 16 lines, which they call Rumbs: and they cut themselues in the point where wee stand: of which rumbs, that which passeth by the points where the æquinoctiall beginneth and endeth (which are where the Sunne riseth, and setteth the 11 of March, and the 13 of September) is called east and west; and that which cutteth it right acrosse, is named north and south. And the foure extreames or ends of these two lines, are distant vpon the Horizon one fourth part of a circle, and they make foure quarters. Euery one of which quarters being diuided in the midst, doe make foure other points: and that which falleth betweene the north and the east, is called north-east; and that betweene the north and the west, north-west; that betweene the south and the east, south-east; and that betweene the south and the west, south-west. And so the Horizon is diuided by foure lines or rumbs, into eight principall windes, noted in the Sea-Chart with blacke lines. And if you diuide euery one of those eight parts in the midst, you shall haue other eight lines, and other foure rumbs, which in all are sixteen windes. And each one of these hath his name compounded of the names of those principall winds which are on either side therof. As for example, that halfe winde which is betweene the north and the

north-

north-east, is called north north-east, and that which bloweth betweene the east and the north-east, is called east north-east; and that betweene the east and the south-east, east south-east; and that betweene the south and the south-east, south south-east; and that betweene the south-west and the west, west south-west; and that betweene the west and north-west, west north west; and that betweene the north-west and the north, north north-west. And these are noted in the Chart with greene lines.

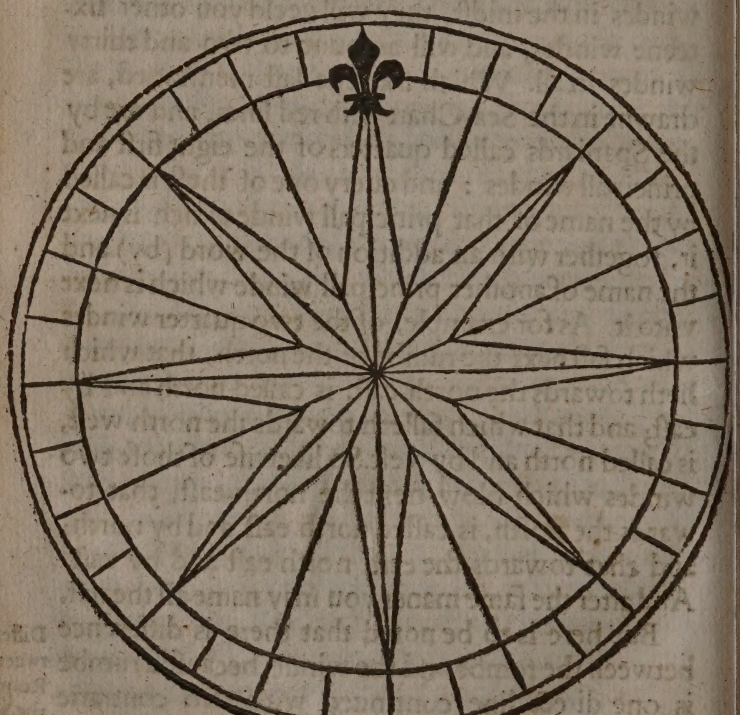
Finally, if you diuide euery one of these sixteene windes in the midst, they will yeeld you other sixteene windes, and will amount to two and thirty windes in all. Which sixteene last mentioned, are drawne in the Sea-Chart with red lines, and are by the Spaniards called quarters of the eight first and principall windes: and euery one of these is called by the name of that principall winde which is next it, together with an addition of the word (by) and the name of another principall winde which is next vnto it. As for example, of the two quarter windes which fall next the rumbe of the north, that which lieth towards the north-east, is called north and by east; and that which falleth towards the north-west, is called north and by west. So likewise of those two windes which blow next the north-east, that towards the north, is called north-east and by north; and that towards the east, north-east and by east. And after the same maner you may name all the rest.

But here is to be noted that there is difference between the rumbe and the winde, because a rumbe is one direct line continued with two contrarie windes, as the rumbe of north and south, and the rumbe

Difference betweene the Rumbe and the winde.

rumbe of east and west. And so when we will name the lying of any coast, we will say that it lieth north and south, or north and by east, and south and by west. But the winde is one line of those 32, into which the Horizon is diuided; and it is one part of those two which together are called the rumb. And so we say, that land lieth from vs towards the south, or towards the South and by west, or towards the south south-west,&c.

The figure of the Sea Compasse, and of the Horizon; diuided into 32 windes, by 16 rumbes.



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Chap. XVII.

Of the two Tropickes.

BEsides the six circles aboue mentioned, which are drawne vpon the superficies of the Sphære of the world, there are other two which the Sunne describeth with the motion of the Primum mobile, about the twelfth day of Iune and of December: of which two circles, that which the Sunne describeth the twelfth of Iune, from the time of his rising, til the time that he riseth the day following, is called the tropicke of the summer sun-standing; or the tropicke of *Cancer*: for the Sun hauing departed from the æquinoctiall, and increasing his declination towards the north, when he commeth to describe that circle, for two or three daies it seemeth that he commeth no neerer to our Zenith, nor departeth from the æquinoctial one day more then another: but frō thence forwards he goeth backe, diminishing his declination till he come to the æquinoctiall; and crossing the same, he goeth on the other side, increasing his declination vntill the twelfth of December, vpon which day, from the time of his rising, till hee be come about to rise againe the next morning, he describeth another circle called the tropicke of the winter Sun-standing, or the tropicke of *Capricorne*; for the Sunne being departed from the æquinoctiall, and increasing his declination towards the south, when he commeth to describe that circle, it seemeth for two or three daies, that he returneth not one

whit towards the æquinoctiall, nor goeth further from our Zenith one day more then other; but from thence forwards he commeth backe againe, diminishing his declination, till he be returned to the æquinoctiall, and from thence towards our Zenith. These two circles in Sea-Charts are marked with two great red lines drawne from East to West, which lie on either side of the æquinoctiall, being distant from thence about 23 degrees and ½. And whereſoeuer our ship be in any place betweene these two circles or lines, we may in some time of the yeere take the Sunne in our Zenith, at which time it maketh no shadow at all, being then iust 90 degrees high aboue our horizon. But they which are without the said two circles or lines, shall neuer haue the Sun in their Zenith, because it cannot come to the height of 90 degrees aboue their horizon.

Chap. XVIII.

Of the Parallels.

THe parallel circles are those which are in all parts æqually distant from the æquinoctiall. And these circles may be infinite betweene the æquinoctiall, and the north and south poles; and in the Sea-Chart some of them are represented by the lines which are drawne from east to west. And two of these circles are the two tropicks of *Cancer* and *Capricorne*, which are the bounds of the Sunnes greatest declinations. Likewise all those circles which the Sunne and the starres in heauen doe by the motion

tion of the first or highest moueable heauen describe from East to West, are parallels, and serue in the sphære to shew the latitude. And when a ship saileth in the same height of the pole, then she saileth in a parallel, and runneth alwaies East or West. Which manner of sailing we vse, at all such times, when wee finde our ship in the height of that land to which we are going.

Chap. XIX.

Of the Degrees.

EVery one of these circles is diuided into 360 æquall parts, which they call degrees, and euery degree is diuided into other 60 æquall parts, which are called minutes: which degrees and minutes, are the common measure that wee vse in nauigation, when wee make any account in the heauens, either in taking the height of the Sunne and starres aboue the Horizon, or in measuring the distance from our zenith to the æquinoctial. These degrees are marked in a line drawne from North to South in the most vacant part of the Sea-chart. This line in generall Sea-charts is diuided into 90 æquall parts, which are counted (beginning at the æquinoctiall line) from one to 90, both Northwards and Southwards. And in those Charts which are not general, this line hath such diuisions as it is capable of, according to the largenesse of the Chart, beginning to make account from the æquinoctial.

Chap. XX.

What is meant by longitude and latitude.

THe longitude of any place is a part of the æquinoctiall, or of some other parallel contained betweene two meridians: whereof one passeth by the Canarie Ilands, and the other by the place giuen; but if neither of ỹ said meridians passe by the foresaid Ilands, it is called respectiue longitude. And this respectiue longitude is called in the art of Nauigation the distance or length of the right line, which is determined or bounded by two other right lines running North and South; of which two, the one passeth by the port or hauen from whence wee set saile, and the other by the place where our ship is. And so shal the distance of the right line, be ~~one~~ the part of any right line whatsoeuer running East and West, comprehended betweene the two foresaid right lines extended North and South.

The latitude of a place is a part of any meridian whatsoeuer contained between two parallels, whereof one is the æquinoctiall, and the other the parallel of the place giuen. This latitude the mariners doe call the distance from the line: vnderstanding by the line the most principall of all others which are drawne in the Chart, that is, the æquinoctiall line. They vse also to call it the heigth, which is as much to say, as the heigth of the pole aboue the Horizon. And so the distance from the æquinoctiall shall be a part of any North and South line contained betweene

The æquinoctial is called the line, because it is the principall of all others which are drawne in the Chart.

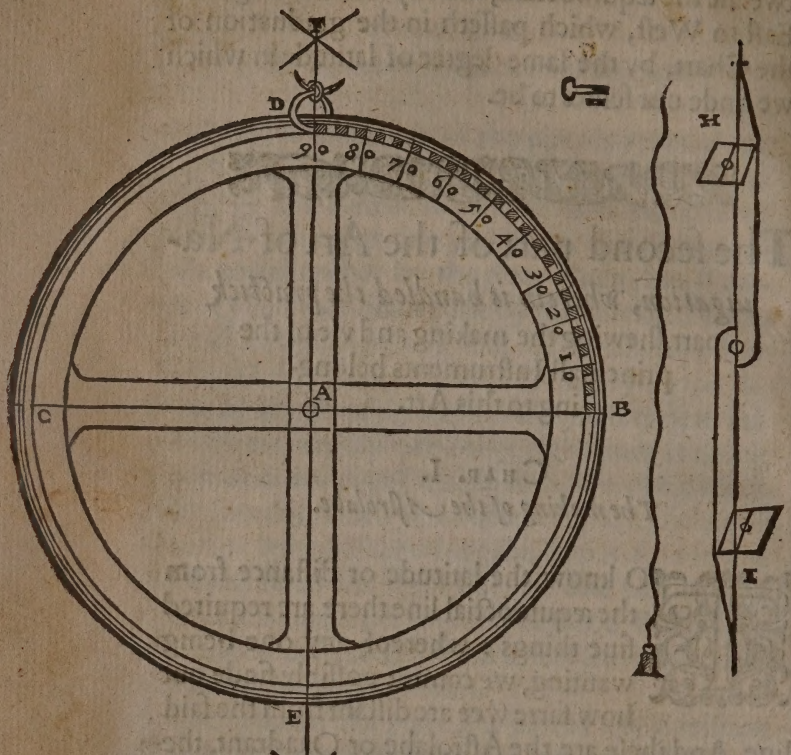
tweene the æquinoctiall, and any line running from East to West, which passeth in the graduation of the Chart, by the same degree of latitude in which we finde our selues to be.

The second part of the Art of Nauigation, *wherein is handled the practick* part, shewing the making and vse of the principall Instruments belonging to this Art.

Chap. I.
The making of the Astrolabe.

TO know the latitude or distance from the æquinoctial line there are required fiue things: whereof any one being wanting, we cannot possibly finde out how farre wee are distant from the said line. And these are, the Astrolabe or Quadrant, the height of the Sunne, the shadowes, the declination, the regiment or rules of the Sunne.

The Astrolabe is to be made after this manner: In the midst of a round plate or table of metall or wood being smooth and plaine euery where and about a finger thicke, you shall take the center A, wherein hauing placed one foote of your compasses, you shall with the other draw as great a circle as conueniently you can in the said table. And within



this circle must be drawne two other circles, the one distant from the other about the breadth of a graine of wheate, and the third must be distant from the second twice so much as the second is from the first.

And your ruler being laid iust to the center A, you

you shall draw the line B, A, C, which diuideth euery one of the three circles into two equal parts. And putting one point of your compasse (standing open according to the length of the line B C) vpon the point C, where the greatest circle is diuided by the line B C; with the other point, you shall draw aboue the point D a part of a circle, and another vnder E. And then putting one foote of the compasses thus opened vpon the point B, you shall draw other two parts of a circle which will crosse the first in F and G. And your ruler being laid to F and G, you shall draw the line D E which must passe by the center A. Then let the quadrant D B be diuided into three equal parts: and euery one of those into three other parts, and each of those 9 into two, and euery one of those 18 into 5; and so the said quadrant shall be diuided into 90 equal parts or degrees. Vnto which degrees shall be placed the numbers belonging to them from 5 to 5, between the second and the third circle beginning from B, and ending with 90 at the point D. Then let there be made at the point D a little hole vpon the line D E, through which may be put a little ring, or some strong ribband, or string: and you shall make a knot thereon, whereby your finger may take hold: and the Astrolabe hanging by that hole, you shall put through a slender threed with a plummet of lead, which may hang quite vnder the Astrolabe; which threed, if (while the Astrolabe hangeth immoueable) it fall iust vpon the line D E, then is the Astrolabe well rectified: If not, you must continue cutting off some thing, & lightning that side towards which the threed doth fall,

vntill it hang euen with the foreſaid line. Then muſt you draw vpon a ruler of the ſame matter, (being about a finger and an halfe broad) the right line H I along through the very midſt of the breadth thereof: which ruler ſhall be made after the ſame faſhion that here is ſet downe, cutting away from one halfe of the length, halfe of the breadth, alwaies ſauing whole the line H I. And ſo likewiſe ſhall you cut off along the halfe of the length on the contrary part, halfe of the breadth; ſo that the line H I may remaine whole on that ſide alſo. And neere to the ends of the ſaid ruler, you ſhall ſet two little ſquare fanes of the breadth of the ruler in the midſt, ſtanding vpright, the very midſt of both fanes being placed vpon the line H I. Through the centers of which two fanes ſhall be made two little holes, both which muſt ſtand directly ouer the line H I, and in equall diſtance from the vpper face of the ruler. This ruler by a hole bored thorow the midſt thereof, ſhall be faſtned vpon the ſaid Aſtrolabe through another hole of the bigneſſe of that in the ruler, at the very center A with a naile, which may be made faſt with a little pin, as is to be ſeene in the figure.

Chap. II.

Of the heigth of the Sunne.

TO take the heigth of the Sunne, you muſt hold the Aſtrolabe by the ring or knot D, in your left hand: and turning your right ſide to the Sunne, lift vp the ruler with your right hand, till the beame of the Sun entring by the hole of

of the vppermoſt vane, doth alſo pearce thorow the hole of the nethermoſt vane: And then note the degree, and part of the degree which the line H I doth touch; for that is the heigth of the Sun aboue the Horizon; which if it be the greateſt heigth that the Sun hath that day, it will teach vs how farre we are diſtant from the æquinoctiall. This greateſt heigth is to be taken at midday, lifting vp the vppermoſt vane, till wee be aſſured that the Sun ceaſeth to riſe any higher, but beginneth to fall againe. Then note that greateſt heigth, and keepe it for the making of your account of the latitude by the Sunne.

Chap. III.

Of the ſhadowes.

THE ſhadowes being compared with the Sun, may be of three ſorts: for at high noone the ſhadow falleth either towards that part of ỹ world to which the Sunne declineth, or towards the contrary part, or elſe we make no ſhadow at all. The firſt and ſecond ſort are, when the heigth of the Sun is leſſe then 90 degrees, and the third is when it is iuſt 90 degrees high. The firſt is when the Sun keepeth his courſe on the North ſide of the æquinoctial, which is from the 11 of March to the 13 of September; and likewiſe when the ſhadowes fall towards the North of the Compaſſe: or when the Sunne runneth on the South ſide of the æquinoctial, (which is from the 14 of September to the 10 of March) and the ſhadowes likewiſe fall towards the

the south of the Compasse: and this is when the Sun and the shadowes goe both one way. The second is, when the Sunne comming towards the North, the shadowes are cast towards the South of the Compasse; or when the Sunne is on the South side of the æquinoctial the shadowes fall towards the North: and this is, when the Sun and the shadowes are differing.

The rule of the shadowes is, that wee looke well to the lower fane of the Astrolabe when wee are taking the height of the Sun at noone: For if the line H I fall directly vpon the line of the Astrolabe D E, then we haue no shadow, because the Sun is in our zenith 90 degrees high. But if the line H I fall not vpon the line D E, you must marke towards what part of the world the lower part of the ruler doth decline frō the point E; which if it decline towards the North of the Compasse, then the shadowes fall Northwards. But if it decline towards the South of the Compasse, then the shadowes fall Southwards.

Chap. IIII.

Of the regiment and rules of the Sunne.

When you know the part, or parts of the Sunne and shadowes, and desire by the Sunne to know how farre you are distant from the æquinoctiall, you haue fiue rules: The first whereof sheweth in what part of the heauens the Sunne is, that is, whether he be North or South from the æquinoctiall at the time of your obseruation. The second teacheth

teacheth what account we are to take of the Sunne, when he casteth no shadow, because he is in our zenith, and is found in the Astrolabe to be iust 90 degrees high. The third is, of the account to be made by the Sun, when taking the heigth thereof in lesse then 90 degrees, it maketh a shadow at high noone, and hath no declination because it is vnder the æquinoctiall. The fourth is, of the account that is to be made, when the Sun and the shadowes are both one way from the line. The fifth is, when the Sunne and the shadowes are different, one being towards the North, and the other towards the South.

The first rule of the Sunne.

From the 11 of March, to the 13 of September, the Sunne runneth on the North side of the æquinoctiall. And from the 14 of September to the 10 of March he goeth on the South side thereof.

The second rule of the Sunne.

When wee obserue the Sunne in 90 degrees of heigth, we must see what degrees and minutes of declination the Sun hath the same day: And then we may say, that wee are so much distant from the equinoctial towards that part of the world to which the Sunne declineth.

The third rule of the Sunne.

When the Sunne is lesse then 90 degrees high, if there be no declinatiõ the same day, then so much as it wanteth in heigth of 90 degrees, so much are we distant from the æquinoctiall, towards that part of the world towards which the shadow falleth.

The fourth rule of the Sunne.

When the Sunne and the shadowes are both towards

wards the ſame part of the world, we muſt note how much the Sunne wanteth of 90 degrees in height. And that which it wanteth (being added to the declination of the Sunne the ſame day) is our iuſt diſtance from the æquinoctiall towards that part of the world to which the Sunne and ſhadowes decline.

The fifth rule of the Sunne.

When the declination of the Sunne, and the ſhadowes be different, we muſt adde the heigth of the Sunne vnto the declination which it hath the ſame day: And if the Sun amount to 90 degrees iuſt, then are we vnder the æquinoctiall line: but if it exceed 90 degrees, wee are ſo much diſtant from the æquinoctiall towards that part of the world wherein the Sunne is, as that exceſſe or ouerplus commeth to. And if the heigth and declination added together come to leſſe then 90, looke how many degrees and minutes you want of 90, ſo many are you diſtant from the æquinoctiall towards that part to which the ſhadowes fall.

And here is to be noted that wee muſt likewiſe make account of the minutes, becauſe they may be both in declination, and in heigth, and ſo alwaies in that declination where wee ſhall finde 60 minutes, we muſt make of them one degree. And if in taking the heigth wee finde halfe a degree beſides all the whole degrees, it is as much as 30 minutes, and one third part of a degree is 20 minutes, one fourth 15 minutes, one fifth part 12 minutes, and one ſixth part 10 minutes.

Chap. V.

Of the declination of the Sunne, and of his tables.

THat wee may know what vſe to make of the fiue foreſaid rules of the declination of the Sun, we are to note, that the yeere (which is the time of the Sunnes motion from any point of the ecliptick till hee returne againe to the ſame point) conſiſteth not alwaies of an equall number of daies. For beſides 365 daies it containeth almoſt one quarter of a day: but the yeere which we commonly account containeth 365 daies in common yeeres, and in leape yeers 366. It was therefore needfull to make foure tables of twelue moneths apeece (whereof the three firſt containe 365 daies, and the fourth 366) and in ſuch ſort to diſtribute the declination of the Sun among them, that you may make account of the declination which is wanting to the Sun at the end of 365 daies, for lack of thoſe ſixe houres almoſt which the Sun wanteth to come vnto the point, from which it departed at the beginning of the yeere: and alſo of the declination which reſulteth in the fourth yeere, becauſe it conſiſteth of 366 daies, at what time it commeth to recouer that which in the three former yeeres it had loſt. Therfore to know at al times which of the foure tables we ought to make vſe of, I will ſet down a rule whereby you may know whether the preſent yeere be leape yeere, or whether it be the firſt, ſecond or third yeere after the leape yeere.

And

And the rule is this, that taking from the yeeres of our Lord (which run in our common account) the number of 1600, if the remainder thereof be an euen number, and halfe of the remainder an euen number, then that yeere is leape yeere: and if the remainder be euen, and the halfe thereof odde, then that yeere is the second yeere after the leape yeere. But if the remainder of the yeeres number be odde, we must trie the yeer next going before, to see whether the remainder thereof, and halfe the remainder be euen numbers, for then the present yeere is the first after the leape yeare. And if the remainder of the yeere going before be euen, and the half thereof odde, then the present yeere is the third yeere after the leape yeere.

How the declination of the Sun may be found out.

Now to know the Suns declination euery day, we must looke in that table which answereth to the present yeere, and seeking the moneth in the vpper part of the page, and the day of the moneth wherein we would know the declination, in the columne which descendeth towards the left hand; right ouer against the said day, and vnder the title of our moneth, wee shall finde two numbers; one of degrees, and the other of minutes; which are the declination of the Sunne that day, toward that part of the world which the first rule of the Sunne doth teach.

Chap. VI.

The æquation of the Sunnes declination.

THey which saile in the moneth of Iune and December neede not much to make any æquation, in the table of the Sunnes declination, because that in those moneths the declination of one day differeth very little from the declination of another. But at all other times of the yeere we ought to make some kinde of æquation to know precisely our heigth, or our distance from the æquinoctiall. This æquation is to be made after this manner: You must subtract the declination of the Sunne for the present day from the declination of the day following, or contrariwise (subtracting alwaies the lesse out of the greater) and the difference, or remainder shal be multiplied by the leagues which our ship hath sailed from the meridian of *London*; and the product of the multiplicatiō must be diuided by *7200 leagues, which are contained in the compasse of the whole earth: then (if you haue sailed westward) the quotient must be added to the declination of the Sunne that day, if it be from the 11 of March to the 12 of Iune; or from the 13 of September to the 12 of December: or it must (if the shippe also hath sailed Westward) be subtracted if you finde it in any other time of the yeere, except in the daies of the æquinoctium: for then this difference is known by taking the declination of the present day with that of the day following: but if you be to the Eastward

*These leagues must be counted in the æquinoctial betweene the meridians of the two places. But it were better to finde the difference of longitude: for the as 360 degrees are to that difference; so is the difference of declination to the æquation desired.

ward from the meridian of *London*, you must doe contrariwise, subtracting the said æquation where before you added it.

In stead of the table of the Sunnes declination here inserted by Roderigo Samorano, *use the table before set downe from the 399 page, to the 423 page.*

Chap. VII.

Foure examples for the plainer declaration of that which is said before.

An example of the second rule.

IN the yeere 1608 the 15 of April, suppose I was sailing, and tooke the heigth of the Sunne with my Astrolabe at noone, and found the heigth thereof to be iust 90 degrees. First therefore I tooke from 1608 the number of 1600, and there remaine 8, which remainder being an euen number, and foure the halfe thereof being euen also, I say the yeere 1608 is the leape yeere. And so I goe vnto the fourth yeere in the table of the Sunnes declination, which is leape yeere, and vnder the moneth of April, ouer against the 15 day, I finde 13 degrees and 25 minutes, 41 seconds: I say therefore that I am distant from the æquinoctial towards the North 13 degrees and 26 minutes almost, because it is betweene the 11 of March and the 13 of September, in which space falleth the 15 day of April.

The second example of the third rule.

In the yeere 1602 vpon the 13 day of September, admit I tooke the heigth of the Sunne, and found it in my Astrolabe to be 70 degrees and an halfe: and

that

that in the table of declination belonging to the ſame yeere, vpon the foreſaid day of September, I found that the Sun had no declination, but that it was vnder the very æquinoctiall line. Now becauſe the degrees of the heigth which the Sun wanteth of 90 are 19 and an halfe, I ſay that I am ſo much diſtant from the æquinoctiall toward that part of the world vnto which the ſhadow falleth.

Example of the fourth rule.

Vpon the 13 of May 1609, ſuppoſe I tooke the heigth of ☉ Sun at noone in my Aſtrolabe, & found it to be 85 degrees and three quarters. Now becauſe 1609 is an odde number, I goe back to the former yeere of 1608, and I finde (according to the rule of leape yeeres) that the yeere 1608 is leape yeere, and hence I iudge that the yeere 1609 is the yeere next following the leape yeere.

Then I goe to the tables of declination belonging to the firſt yeere after the leape yeere, and vnder the moneth of May againſt the 13 day, the Suns declination is found to be 20 degrees, 41 minutes, 15 ſeconds: and becauſe that from the 11 of March to the 13 of September the Sun keepeth his courſe to the Northwards of the æquinoctial, hauing marked the ſhadow at midday, I ſee that the lower vane of mine Aſtrolabe, looketh to the North of the Compaſſe, and ſo I ſay that the Sun and the ſhadow are both one way. Then I looke for the heigth which is 85 degrees, and three quarters, ſo that it lacketh of 90 degrees foure degrees and one quarter, which is fifteene minutes. Theſe foure degrees and fifteene minutes being added to the declination, which is

twentie degrees and 41 minutes, amount in all to 24 degrees and 56 minutes: And ſo much am I diſtant from the æquinoctiall towards the North, which is the part of the Sun and of the ſhadowes.

An example of the fifth rule.

Vpon the 17 of October 1609 (which is the firſt yeere after the leape yeere) the Sun now going his courſe towards the South, ſuppoſe I tooke his altitude in 50 degrees and one third. And when I tooke it, the lower vane of mine Aſtrolabe declined toward the North of my Compaſſe: wherefore I ſay that the Sun and the ſhadowes are different. And ſo adding 50 degrees and 20 minutes (which is one third part of a degree) with 12 degrees and 55 minutes (which vpon that day is the Suns declination) they amount in all to 63 degrees and 15 minutes: which are leſſe then 90 degrees by 26 degrees and 45 minutes: and ſo farre am I diſtant from the æquinoctiall to the part of the ſhadowes, that, is to the North: for the Sun and ſhadowes being different, the heigth and declination came not to 90 degr.

A ſecond example of the fifth rule.

The ſame day and yeere ſuppoſe that ſome man found the Sunne in 77 degrees and fiue minutes of heigth, the Sun it ſelfe declining to the South, and the ſhadowes falling to the North; which being added to 12 degrees and 55 minutes of declination, amounteth in all to 90 degrees, iuſt: whereby I know that the ſhip wherein this altitude is taken, is vnder the æquinoctial: becauſe the Sunne and ſhadowes

dowes being different, the heigth and declination make iuſt 90 degrees.

The third example of the fifth rule.

Vpon the 20 of May 1608, ſuppoſe a certain man found the Sunnes heigth to be 88 degrees and two third parts, the Sun and ſhadowes being different: which being added to 21 degr. 54 minutes, (the Suns declination that day) amounteth to 110 degrees 34 minutes, which exceed 90 by 20 degrees and 34 minutes. I ſay therefore that this man is 20 degrees and 34 minutes diſtant from the æquinoctial, towards the part of the Sun, which is to the North, becauſe the Sunne and the ſhadowes being different, the heigth of the Sun, and the declination being added together exceed 90 degrees.

Chap. VIII.

Another manner of accounting by the Sunne, as they vſe in Portugall.

SOme Aſtrolabes there bee, whoſe account beginneth not from the horizon but from the zenith, and endeth with 90 degr. in the horizon; and the heigth taken by them is nothing elſe but the diſtance of the Sun from our zenith: And to make an account of the Sunne, according to the altitude taken with ſuch Aſtrolabes, there are theſe rules following to be obſerued.

1. When the Sunne and the ſhadowes are both one way, adde the heigth vnto the declination, and

the product will shew how farre you are distant from the line, towards the part of the Sun and shadowes.

2. If the Sunne and the shadow be differing, subduct the declination from the heigth, or the heigth from the declination (the lesser from the greater) and the remainder will shew how farre you are from the line, towards the part of that which is greater: and if the heigth be greater, then are you on the part of the shadowes.

3. When the Sun is in the line and hath no declination, so much altitude as you shall find, so farre are you distant from the æquinoctiall towards the part of the shadowes.

4. When you shall take the Sunne in your Zenith, hauing then no altitude, his declination will shew you how farre you are distant from the line towards the part of the Sun.

These rules, because they are so easie and plaine, need no examples.

Chap. IX.

How the heigth of the Sun may be knowne in any place whatsoeuer without an Astrolabe; first knowing your distance from the æquinoctial.

SOme Pilots for their curiosities sake desire to know the heigth of the Sun for any day without an Astrolabe. For the performance whereof, it is expedient that they know three things: that is to say, the declination of the Sun, the distance of the place from the

the æquinoctiall, and the part whereunto the shadowes doe incline at midday. These three being knowne, you shall come to the knowledge of the Sunnes heigth by foure rules.

1. When you and the Sun be both on one side of the æquinoctiall, if your distance from the line be equall to the Suns declination, you shall finde the Sun in your zenith in 90 degrees, and shall haue no shadow.

2. When the Sun hath no declination, look how much your distance from the æquinoctiall wanteth of 90 degrees, for so much is the heigth of the Sunne.

3. When the Sunne and the shadowes are both towards one part, subtract out of your distance from the æquinoctiall the declination of the Sunne that day, and that which the remainder shall want of 90 degrees, shall be the heigth of the Sun.

4. When the Sunne and the shadowes are different, if the æquinoctiall be betweene you and the Sunne, adde the declination of the Sunne to your distance from the æquinoctial, and that which these two numbers added together shall want of 90 degrees, shall be the heigth of the Sunne. But if you be betweene the Sunne and the line, you must subduct your distance from the line out of the Sunnes declination, and then that which the remainder shall want of 90 degrees, shall be the heigth of the Sunne.

Chap. X.

The rule, or regiment of the North ſtarre, for the knowledge of the heigth of the Pole.

THe zenith is the pole of the Horizon, becauſe it is euery where diſtant from it iuſt 90 degrees. And hence it is that the pole of the world is ſo much eleuated aboue our Horizon, as our zenith is diſtant from the æquinoctiall, which is very manifeſt: for hauing 90 degrees of the meridian from our zenith by the pole of the world to the horizon; and other 90 degrees of the meridian from the pole of the world, by our zenith to the æquinoctial; becauſe they are two quadrants of one and the ſame circle, they muſt needs be of equall quantitie: from both which that part being taken away which is common to both (that is, the whole diſtance from the pole of the world to our zenith) that which remaineth on both parts ſhall be equall. And ſo that ſpace from our zenith to the æquinoctial (which is called the diſtance from the line) is equall to the diſtance that is betweene the pole of the world and the horizon, which is called the heigth of the pole.

Whereby it is manifeſt that the heigth of the pole is ſo much as our diſtance from the line is. And although they are two different things, yet the one is taken for the other becauſe they are equall.

This heigth of the pole is knowne by the help of foure

foure things, which are the Ballestilla or Crosse-staffe, the position of the North starre, the heigth of the said starre, and certaine rules.

Chap. XI.

The making of the Crosse-staffe.

THe mariners Crosse-staffe is that which by the Astronomers is called *Radius astronomicus*: and the manner how to make it is as followeth: First, vpon a very plaine and broad table you may draw a semicircle, which from the center to the circumference must containe at the least foure hand breadths. And hauing drawne thorow the center thereof the line A B C, diuide the circumference into two equall parts, in the point E; as likewise you must diuide the quadrant E C in the very midst by the point F. Then must you diuide the arch E F into 90 equall parts, diuiding it first into three, and euery of these three into other three, and euery of those nine into two, and each of those two into fiue, which you must doe with much precisenes and care. Then laying your ruler to the point B (which is the center) through euery one of those 90 diuisions of the halfe quadrant you must draw 90 lines: And keeping this quadrant so diuided, it will serue you for a paterne to make as many Crosse-staues as you think good, of what bignes soeuer you will. But to make the Crosse-staffe, you must take a peece of wood of some three foote in length, and a finger thick, foure square, and very euen: and fitting a transuersarie

thereto, which may with facilitie slide vp and down vpon the staffe, alwaies right acrosse; take with your compasses halfe the length of the transuersarie, and placing one foote of the compasses vpon the point B, make with the other a marke in the line B C, which may serue for the point G, and draw thorow the point G the line G I, which may runne equally distant from the line E B. Finally, laying one end of the staffe vpon the point G, let it lie all along iust vp-

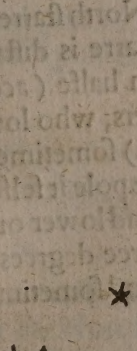
on

on the line G I, and make you markes vpon the edges of the ſtaffe, by which you may draw 90 lines, putting the number of euery line, vpon the ſaid edge, beginning to place 90 where the line BE doth croſſe the ſtaffe, and from thence deſcending vnto one or two, which may be put downe according to the length of the ſtaffe and the largeneſſe of the tranſuerſarie.

Chap. XII.

Of the poſition of the North ſtarre, and the guards.

AMongſt the 48 conſtellations, which the Aſtronomers place in the heauens, the neereſt vnto the pole of the world is that which they call the leſſer Beare, and the mariners Bozina, or ỹ horne, in regard of the faſhion thereof: which conſtellation conſiſteth of 7 ſtars, which are placed after this maner: And of theſe ſtars the three greateſt marked with the letters ABC doe ſerue eſpeciallie for our purpoſe. And ſo A is called the North ſtarre; B the formoſt guard; C the other guard behinde. And they are ſo called, becauſe that by force of the motion of the firſt moueable heauen the ſtarre B goeth



alwaies

alwaies before, and the ſtarre C behinde. Euery of theſe three ſtarres as well as al others in the heauens beſides, deſcribe their circles round about the pole, with the motion of the firſt, or higheſt moueable heauen: in which motion, ſometimes the two ſtars A B are iuſt of one heigth aboue the Horizon: and then they are ſaid to be Eaſt and Weſt one from an other. Sometimes they are in a perpendicular line to the Horizon according to our ſight; and then they are ſaid to bee North and South: and ſometimes alſo the two guards B C are Eaſt and Weſt one from another, and then the former guard beareth from the North ſtarre Northeaſt and Southweſt. And when theſe two guards be in a perpendicular line one aboue another, the former guard beareth from the North ſtar Northeaſt and Southweſt. In ſo much that from theſe foure poſitions do ariſe eight rules for the eight rumbes, wherein the former guard may ſtand, being conſidered in reſpect of the North ſtarre. And ſo preſuppoſing that the Northſtarre is diſtant from the pole three degrees and an halfe (according to the opinion of ſome mariners, who loue numbers that haue not any fractions) ſometime the North ſtarre ſhall bee as high as the pole it ſelfe, ſometime three degrees and one ſecond Halfe lower or higher then the pole, and ſometime three degrees, and ſometimes one and one ſecond Halfe, and ſometime halfe a degree.

Halfe

Halfe

CHAP.

Chap. XIII.

Of the heigth of the ſtarre taken with the Croſſe-ſtaffe.

TO know how much the North ſtarre is eleuated aboue the Horizon, you muſt take the heigth thereof onely at ſuch times when as in reſpect of the former guard it is in ſome one of theſe foure rumbes, that is to ſay, North and South, Eaſt and Weſt, Northeaſt and Southweſt, and Northweſt and Southeaſt. Wherefore ſeeing it placed in any of the foreſaid rumbs, you ſhal put that end of the Croſſe-ſtaffe which is next 90 degrees vpon your cheek-bone, at the vtter corner of your eye: & holding it there ſtedfaſt, you muſt moue ỹ tranſuerſarie till you ſee the Horizon ioyned with the lower end thereof; and the North ſtarre with the higher end. Then marke the degree, and part of the degree which the tranſuerſarie ſheweth vpon the ſtaffe; for that is the heigth of the ſtarre.

Chap. XIIII.

The regiment or rules of the North ſtarre.

The firſt rule.

WHen the guards are in the Eaſt, the former guard beareth with the North ſtarre Eaſt and Weſt; and then the North ſtarre is a degree and halfe vnder the pole: let vs adde this degree and one ſecond to the heigth which we obſerued

ued with the Croſſe-ſtaffe; and the whole product ſheweth the number of degrees which the pole is eleuated aboue our Horizon. And ſo much are we diſtant from the æquinoctiall toward the North.

The ſecond rule.

When the guards are in the Northeaſt, one guard beareth from another Eaſt and Weſt: and the former guard ſtandeth from the North ſtarre Northeaſt and Southweſt; and then the North ſtarre is vnder the pole three degrees and one halfe; which being added to the heigth of the ſtarre, will ſhew you the heigth of the pole.

The third rule.

When the guards be at the higheſt, then the former guard beareth from the north ſtarre north and ſouth, the north ſtarre being then three degrees vnder the pole: which three degrees being added to the heigth of the ſtarre, doe ſhew the true heigth of the pole.

The fourth rule.

When the guards are in the northweſt, they beare one from another north and ſouth, and the former guard lieth from the north ſtarre northeaſt and ſouthweſt: and then the north ſtarre is vnder the pole halfe a degree: which halfe degree being added to the heigth of the ſtarre, giueth you the heigth of the pole.

The fifth rule.

When the guards are in the eaſt, the former guard lieth from the north ſtarre eaſt and weſt, and then the north ſtarre is a degree and an halfe aboue the pole;

pole, which degree and an half being deducted out of the heigth of the north ſtarre, the remainder is the iuſt heigth of the pole.

The ſixth rule.

When the guards are in the ſouthweſt, one beareth from another eaſt and weſt, and the former lieth from the north ſtarre northeaſt and ſouthweſt, and then the north ſtarre is aboue the pole three degrees and an half: which three degrees and an half being deducted out of the heigth of the ſtarre, that which remaineth ſhall be the heigth of the pole.

The ſeuenth rule.

When the guards are at the loweſt, the former guard beareth with the north ſtar north and ſouth: and then the north ſtarre is aboue the pole three degrees; which being deducted, the remainder is the heigth of the pole.

The eigth rule.

When the guards are in the ſoutheaſt, one beareth from another north and ſouth, and the former beareth from the north ſtarre northweſt and ſoutheaſt, and the north ſtarre is aboue the pole halfe a degree: which halfe degree being deducted from the heigth of the ſtarre, the remainder is the heigth of the pole aboue our Horizon, and iuſt ſo much are we diſtant from the æquinoctial towards the north.

This is the account which alwaies hath bin made of the north ſtarre from the time that it hath had three degrees and an halfe diſtance from the pole vnto this preſent. But becauſe at this time by reaſon of the compound motion of the 8 and 9 heauens, the fixed ſtarres haue notably varied from their places,

In stead of all these rules of the North star (which are erroneous) vse the table of æquatiõs of the Pole starres height, set downe in the latter end of this booke.

places, the pole starre hath also approched neerer the pole, being now distant therefrom not aboue three degrees and eight minutes. And so I thinke it conuenient to set downe the account which ought now to be made thereof according to the foresaid distance: to the end that from hencefoorth the heigth of the pole taken by the starre may agree iustly with the distance from the æquinoctial taken by the Sun. Which two things haue hitherto disagreed and caused no small confusion vnto the Pilots, and some error in nauigation.

The guards being in the	East,	you shall adde vnto ỹ heigth taken by the Crosse-staffe,	1 degree 20 min.
	Northeast,		3 degrees 8 min.
	North,		2 degrees 41 min.
	Northwest,		0 degree 27 min.

In the contrary rumbes to these you must deduct these degrees from the heigth of the starre, which you take with your Crosse-staffe, and then you shall haue the heigth of the pole aboue the Horizon.

Chap. XV.

Other things to be noted in obseruing the heigth of the Pole.

NExt vnto the constellation of the Horne there is a starre which is called by the Spaniards *el guion*, signified before by the letter D, which standing east and west from the north star, giueth you to vnderstand, that it, and the north starre, and the very pole are east and west. And so taking the heigth of the north starre, when it is thus situate in regard of the *Guion*, without making any

other

other account, you haue the iuſt heigth of the pole and the diſtance from the æquinoctiall.

Sometimes alſo it falleth out, that being verie neere vnto the line, or for ſome other cauſe, the guards cannot be ſeene how they lie from the north ſtarre. For remedie whereof there are three ſtarres, by which (ſeeing any of them and the north ſtarre, albeit you cannot ſee the guards) you may know the heigth of the pole, and theſe are the ſtarres which the mariners call the third, the ſixth, and the ninth. The third is the head of that conſtellation which the Aſtronomers call the Dragon, & it maketh with two other ſtarres that follow it, this figure: The ſixth is the right foote of *Cepheus:* and the ninth is the left foote. The third was ſo called, becauſe it commeth vnto euery third rumbe three houres after the former guard; and the ſixth is ſo called, becauſe it commeth ſixe houres after the former guard; and the ninth, becauſe it commeth nine houres after the former guard. Whereof it followeth, that when the third ſtarre is directly aboue the north ſtarre, the former guard is in the northweſt, the ſixth ſtarre in the northeaſt, and the ninth in the eaſt. And to know this in the other rumbes, you may peruſe the table following; wherein is manifeſtly ſet down where the guards are, and how they are ſituate, in what rumbe ſoeuer any one of theſe three ſtarres is found. So that it will be an eaſie matter to know the place of the guards, and the heigth of the pole, the heigth of the pole ſtarre being found, and the place of the third, ſixth, or ninth ſtarre.

Here followeth the Table.

The guards being in the	East Northeast North Northweſt Weſt Southweſt South Southeaſt.	The third ſtarre is in the	Southeaſt East Northeaſt North Northweſt Weſt Southweſt South.	The ſixth ſtarre in the	South Southeaſt Eaſt Northeaſt North Northweſt Weſt Southweſt	The ninth ſtarre in the	Southweſt South Southeaſt Eaſt Northeaſt North Northweſt Weſt.

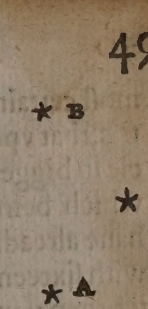
In this table the firſt columne ſerueth for the guards; the ſecond for the third ſtarre; the third columne for the ſixth ſtarre; and the fourth for the ninth ſtarre. In ſo much as if you ſeeke the rumbe, ſeeing any of theſe foure ſtarres in this table, right againſt the ſame doe anſwere thoſe rumbes where the other three are, although we cannot ſee them in the heauens.

Chap. XVI.

Of the Croſiers.

When the mariners paſſe the æquinoctiall line towards the South, ſo that they cannot ſee the North ſtarre, they make vſe of another ſtar, which is in the conſtellation called by the Aſtronomers the *Centaure:* which ſtarre, with other three notable ſtarres, which are in the ſame conſtellation, maketh the figure of a croſſe; for which cauſe they call it the *Croſier.* And it is holden for certaine, that when the

the ſtarre A (which of all foure commeth neereſt to the South pole) is North and South with the ſtarre B, that then it is rightly ſituate to take the heigth by. And becauſe this ſtarre A (which they call the Cocks foote) is thirtie degrees from the South pole, it commeth to paſſe that if being ſituate, as is aforeſaid, we take the heigth thereof (which is then the greateſt that it can haue) this heigth will truly ſhew how farre we are diſtant from the æquinoctiall. For if the ſaid heigth be thirtie degrees, then wee are in the very æquinoctiall: and if it be more then thirtie degrees, then are wee by ſo much paſt the æquinoctial towards the ſouth. And if it be leſſe then thirtie degrees, ſo much as it wanteth are we to the north of the æquinoctiall.



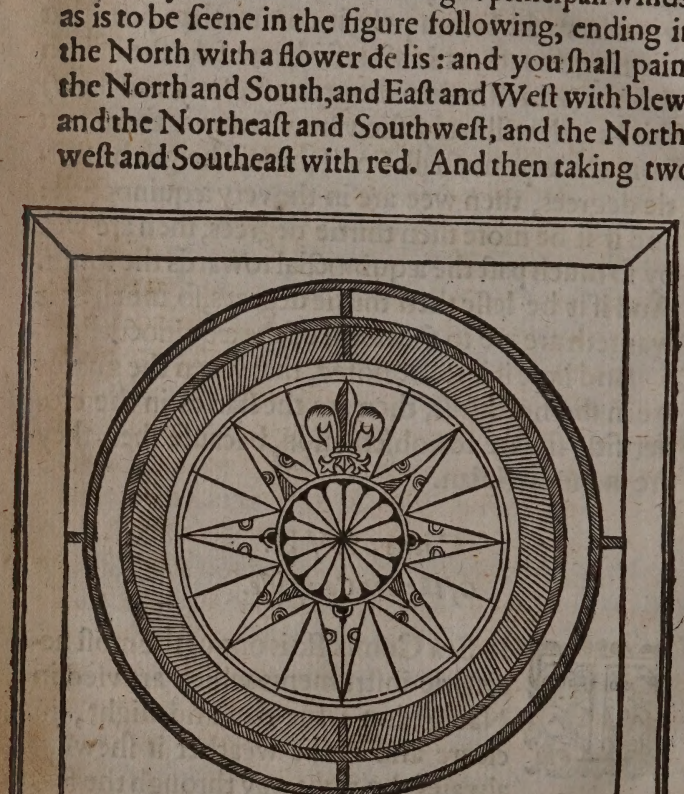
And here it is to be noted, that when the guards are in the northeaſt, then are the ſtarres in the croſier fitly ſituate for obſeruation, becauſe then they are in the meridian.

Chap. XVII.

Of the Sea Compaſſe.

THe Sea Compaſſe is one of the moſt neceſſarie inſtruments which are vſed in Nauigation: for day and night, in cleere and darke weather it ſheweth alwaies the right way through the ſea. And therefore it is meete that this inſtrument bee made with much care, to the end that it may be

most certaine and true. And the manner of making ti is, that vpon a peece of pastboord, you draw a circle so bigge as you will haue your Compasse to be: which being diuided into 32 equall parts (as wee haue alreadie shewed in the Chapter of the winds) with sixteene lines crossing one another in the center, then you shal adorne the eight principall winds, as is to be seene in the figure following, ending in the North with a flower de lis: and you shall paint the North and South, and East and West with blew, and the Northeast and Southwest, and the Northwest and Southeast with red. And then taking two



steele

ſteele wires, which are to be placed like the head of a launce, you muſt faſten them on the backſide of the ſaid circle, in ſuch ſort that one meeting of the points of thoſe ſteele wires be right vnder the north, allowing halfe a point towards the northeaſt, in regard of the northeaſting of the needle at Seuil: and the other meeting at the oppoſite point, which is ſouth, and half a point towards the Southweſt: and touching or rubbing thoſe two points of the wires with the ends of the Loadſtone, which looke to the north and to the ſouth, to wit, the north points of the wires with the ſouth of the ſtone; and the ſouth point of the wires with the north of the ſtone. This being done, you muſt place vpon the center of the ſaid circle a capitell, which muſt be very well bored in forme of a round piramis, to the end that the roſe or flie may play more nimbly vpon the pinne. This pinne muſt be made of latin with a very ſharp point, and is to be faſtned vpright in a round box of wood, which muſt bee of the faſhion of a great cup diſh, containing the roſe within it, being couered aboue with a cleere round glaſſe, and the ioynts thereof muſt bee ſtopped with wax, to the end that no winde may enter into the roſe to diſturbe it. There muſt be great care had, that this roſe, with the wires being placed vpon the pinne, may goe nimbly, and may not ſwarue more to the one ſide then to the other, but may ſtand euen and leuell. And when it inclineth towards either part, you muſt put on the contrarie part a little wax, or a thinne plate of lead faſtned vnder the paſtboord which couereth the wires. This box wherein the roſe plaieth vp and

downe hangeth within two hoopes of latin, which are two round circles incloſed one within another, and diſtant aſunder by the ſpace of halfe a fingers breadth, with two nailes of latin which are diametrally oppoſite. And the box being fitly placed within theſe hoopes, you muſt make in the outward hoope two holes, which muſt be diſtant from the foreſaid two nailes a quarter of a circle both waies: And by theſe two holes muſt the outward hoope or circle be faſtned within a ſquare box, or a round, ſo as although that vttermoſt box be toſſed vp and downe euery way with the motion of the ſhippe, yet alwaies the ſuperficies and glaſſe of the inner box may lie leuel with the Horizon. And this being done with care, the inſtrument, which they call the Sea Compaſſe, is fully finiſhed. The manner of vſing the ſame is, when being placed with the box in the midſt of the pup of the ſhip where the bittacle ſtandeth in a right line, which paſſeth from the boltſprit by the midſt of the maine maſt to the puppe, it ſerueth continually to gouerne the ſhip by mouing of the rudder, till the winde or the line of your compaſſe, towards which we deſire to ſhape our courſe, ſtand directly towards the prow or boltſprit of the ſhip. They vſe alſo for the night to marke a point within the inner part of the inner box, which in reſpect of the capitell of the compaſſe, may ſtand directly towards the prow of the ſhip: And alwaies in guiding the ſhippe, you muſt take heed that the ſaid point be continually ioyned with the winde of the roſe towards which you intend your courſe.

Chap. XVIII.

How the variation of the Compasse may be found.

THe mariners vse to examine whether their compasse northeasteth or southwesteth, watching for that purpose, when the former guard beareth with the north starre northeast and southwest, taking a little of the point of north and south. And placing their compasse in an open place, where the north starre may be seene, if the flower de-lis of the rose looketh directly towards the starre, their compasse varieth nothing at all: but if the starre be to the northeast, so much as it varieth from the point of the flower de-lis, so much the compasse northwesteth: and if it varieth to the northwest of the compasse, how much the starre swarueth from the point of the flower de-lis, so much the compasse northeasteth. And in regard of this variation of the compasse there must alwaies allowance be made in the course which is holden. This manner of finding out the variation I do account to be somewhat subiect vnto error: but at land there is another more certaine way by the meridian line, which is to be taken in manner following.

The finding of the meridian line.

In a superficies which is plaine and leuell euery where, and in a place where the Sunne shineth at his

his rising and setting, you must draw certaine circles vpon one center: and hauing pitched a stile vpright in the same center (the head whereof must be approued with a paire of compasses to be equally distant from all parts of one of those circles) obserue you in the morning two or three houres before noone, when the point of the shadow of the stile toucheth the circumference of any of those circles: & hauing made a mark in the touches, take diligent heed in the after noone also when the same point of the shadow turneth about to touch in the same circle, and making another mark in that second touch, diuide in the midst that part of the circle, which is betweene those two markes. Then laying your ruler vpon the point of the diuision, and vpon the center of those circles, draw a line, which shall be your meridian and the true north and south rumbe; vpon which setting your compasse, and laying your ruler ouer the glasse that it may passe along ouer the meridian, and ouer the center or capitell of the rose or flie: either the said ruler lieth ouer the north and south of the Compasse (and then is the Compasse without variation) or the ruler declineth toward the northeast or southwest; and how much it declineth that way, so much the compasse northwesteth: or else it declineth towards the northwest, and then it northeasteth so much as the ruler declineth that way. But to know the variation of the Compasse both at land and sea, wee will deliuer another farre more easie and certaine way, when we come to intreate of the vniuersall Diall.

CHAP.

Chap. XIX.
Of the Sea-chart.

THe Sea-chart is nothing elſe but a liuely picture of the earth and water. And it containeth fiue notable things, which doe concerne as well the true making of the Chart, as alſo the inabling of the mariner to know the way which hee maketh, the place where he is, and the end of his iourney.

The firſt is the laying out of the coaſts of the land; which that it may be truly done, it is meete that euery thing bee ſet downe in the Chart in the ſame courſe, diſtance, and heigth that ſhall be found in nauigation.

The ſecond is, that it containeth not onely the coaſt of the firme land, but alſo all other particularities which doe occurre in ſailing, as namely, Ilands, Iſelets, bankes, or barres, ſhoulds, rocks and flats.

The third is the lines which ſignifie the 32 winds, by the helpe whereof we may ſee whether the parts of the land be well laid out, and in their true courſes one from another. And of theſe windes the blacke are the eight principall, which are called whole windes. The greene be halfe windes, or half parted windes: and the red be the quarters of the windes. You may know in your chart whether theſe windes be well drawne, if you trie with your compaſſes that all points of them be equally diſtant one from another: and that all windes repreſenting the ſame rumbe be parallels: As namely, that one northeaſt

and ſouthweſt rumbe be parallel to another north-eaſt and ſouthweſt rumbe. The fourth is the graduation, in all parts whereof it is meete that the degrees * be equall one to another: and that the parts of the land do directly lie eaſt and weſt from thoſe degrees vnder which they are ſituate. The fifth is the ſcale of leagues, which you may ſee whether it be true, by taking betwixt the points of your compaſſes iuſt foure degrees out of the line of graduation, which being applied to the ſcale of leagues, muſt there agree exactly with 70 Spaniſh leagues, or 80 Engliſh.

* Or rather increaſed proportionally from the æquinoctial line towards the North and South.

By the Sea-chart are knowne fiue things: The firſt is the lying or trending of the coaſt. The ſecond is the diſtance or number of leagues from one coaſt to another. The third is, the latitude or diſtance frõ the æquinoctiall, wherein all lands both continents and Ilands, as alſo euery port, riuer, ile, ſhoald, or banke is ſituate. The fourth is the rumbe or rumbs, by which we are to ſaile from one place to another. The fifth is the point or place where wee are with our ſhip when wee are ſailing. The firſt is knowne with a paire of compaſſes, putting one foote thereof vpon the beginning of the coaſt whoſe trending we deſire to know, and the other foote vpon the rumbe which to our thinking is euery where equally diſtant from the ſaid coaſt. For if one foot of the compaſſes running along the coaſt, the other foote keepeth by the ſaid rumbe, then we ſay the coaſt lieth euen with that rumbe. And if our Compaſſe runneth without ſwaruing one foote from the rumbe, and the other from the coaſt, till the point which

runneth

runneth along the coaſt leaueth it, then from that very place where it leaueth the ſame, wee may ſay that vnto the other place where it began, the coaſt runneth by ſuch a rumbe, as if a man ſhould ſay eaſt and weſt, northeaſt and ſouthweſt, or any other rumbe whatſoeuer.

The ſecond thing (which is the diſtance) may be found by taking betweene the points of your compaſſes out of your ſcale of leagues, (if the diſtance be very great) an hundred leagues, and meaſuring with your compaſſe ſo opened from one place to another: now if in ſo doing it falleth not iuſt, then remembring how many hundreds of leagues there are, you muſt for the meaſuring of the reſt pitch one foote of your compaſſe vpon the point where the laſt hundred ended, and the other foote vpon the land, whoſe diſtance you deſire to know: thē bringing the compaſſe ſo opened to the ſcale of leagues, you ſhall ſee manifeſtly how many leagues the ſaid diſtance ſurmounteth aboue the hundreds. But if the diſtance be leſſe then an hundred leagues, then ſetting the points of your compaſſes vpon thoſe two places whoſe diſtance you deſire to know, and remouing the compaſſe ſo opened to the ſcale of leagues, you ſhall eaſily know the diſtance of one of thoſe places from the other.

The third (which is the heigth or latitude wherein euery port, riuer or Iland ſtandeth) is to be found by pitching one foote of your compaſſes vpon the land, hauen, or cape, whoſe heigth you deſire to know, and the other foote vpon the next eaſt and weſt parallel, and the compaſſe remaining in that

ſort,

ſort, moue the point thereof along the ſaid parallel, or rumbe, to the line of graduation, and there the other foote which lay vpon the land will ſhew you the heigth thereof.

The fourth (which is the rumbe or rumbes by which you muſt ſaile from one place to another) is knowne after this manner: If you be to ſaile by one rumbe only, you may know it by pitching one foot of your compaſſes vpon the place from which you are to depart; and the other foote vpon the verie next rumbe, which to your thinking goeth moſt directly to the place whither you would go; and running by that rumb with one foote of your compaſſe ſo opened, the other foote will touch the place whither you are going. But if it toucheth not the place whither you are going, then pitch one foote of your compaſſes vpon the ſame place, and the other foote vpon the ſecond rumbe, which you ſuppoſe may leade you thither: And placing one foote of another paire of compaſſes vpon the place from whēce we depart, and the other vpon the moſt direct rumb toward the place deſired; theſe two compaſſes running along the rumbes one toward another; you muſt marke where thoſe two points ioine together, one whereof came from the place of your departure, and the other from the place whither you are to goe; and the point where they both concurre is that to which we are to change our courſe.

As for example, if I ſaile from the barre of S. *Lucan*, to fall with *Punta de Naga* vpon the Ile *Tenerife* in time of winter, it is euident that I muſt ſaile ſouthweſt and by ſouth, till I bring my ſelfe eaſt and weſt

with

with *Cape Cantine* in 32 degrees and an halfe: and from thence I must goe southwest and by west: but not all the way, because putting one point of the compasse vpon *Cape Cantine*, and the other point vpon the southwest and by west rumbe next vnto it, my compasse thus running open alongst the said rumbe, the point which departed from *Cape Cantine* will runne on the outside of *Punta de Naga*. But in such a case as this I place one point of one paire of compasses at *Punta de Naga*, and the other point vpon the southwest rumb: Likewise I place one point of another paire of compasses at *Cape Cantine*, and the other vpon the next southwest and by west rumb. Then let these two compasses so opened run by their said rumbes one against another, and then you must looke in what place and heigth the verie point is, where those two points of the compasses which departed from *Punta de Naga* and *Cape Cantin* doe meete: and I say, that when I am come to the said heigth and place, hauing sailed from *Cape Cantine* southwest and by west, then I must change my course and runne southwest.

Chap. XX.

Of the point of imagination.

THe fifth thing to be knowne by the Sea-chart is the point of the ships place, and this they terme to cast a point, or to set a prick vpon the chart: which is no other thing but to finde a point therein which is proportionally distant in the chart from all the lands and

and Ilands there deſcribed ſo many leagues of the ſcale, as there are leagues of diſtance vpon the ſea from the place where you are to the lands, and Ilands round about you, repreſented by theſe that are in the chart. This point is to bee found two waies; either by imagination, or by trauerſing, which may properly bee called geometricall. The point of imagination is vſually found by the firſt of theſe two waies when we ſaile directly by a parallel circle; which is when wee ſaile due eaſt, and weſt, keeping alwaies in one heigth and diſtance from the æquinoctiall: or when we ſaile by any other rumb in cloſe weather, when neither the Sunne at noone, nor the north ſtarre in the night can be ſeene.

This point doth preſuppoſe the knowledge of two things; to wit, the rumbe by which wee haue ſailed, and that is knowne by the Compaſſe, and the leagues which we haue runne; and this hath no certaintie, but is a little more or leſſe then a good mariner, according to his imagination ſuppoſeth that hee hath ſailed, whereof the ſaid point tooke his name.

This point is found in the chart, by taking out of the ſcale of leagues ſo many leagues as a man can well eſtimate that the ſhip hath gone: and pitching one foote of the compaſſe in the place from which you departed, you ſhall ſet the other point in ſuch ſort, that both may bee equally diſtant from the rumb or winde whereby you haue ſailed; & where that ſecond point of your compaſſe ſhall fall, there is your ſhip according to your imagination.

Chap. XXI.

Of the trauerse or Geometricall point.

THe point found by imagination is not so certaine as is conuenient, becauſe it oft commeth to paſſe, either becauſe the mariner hath not made true account of the way that his ſhip hath made, or for ſome other cauſes therewith concurring, that if hee taketh the heigth by the Sun, or by the north ſtarre, after he hath caſt his point, he commeth not to find himſelf in that diſtance from the æquinoctial, which his point of imagination doth ſhew him, but in ſome other diſtance. And to auoid this error there is another way of caſting your point in the chart, which is called *punto de eſquadria* (the trauerſe point) which point preſuppoſeth the aſſured knowledge of two things; one is the rumbe by which you haue ſailed, the other is your diſtance from the æquinoctiall.

For all this art of Nauigation is grounded vpon the courſe, and height which is in quantitie all one with the diſtance from the æquinoctiall. The rumb or courſe is alwaies knowne by the compaſſe, the height by the ſtarre, and the diſtance from the æquinoctiall by the Sunne.

This being knowne, ſet the foote of one compaſſe at the port or place from whence you departed, and the other foote in the next rumbe whereupon you haue ſailed: and placing one point of another paire of compaſſes vpon the line of graduation,

tion, in the degree of your distance from the æquinoctiall, and the other point vpon the next east and west rumbe, let these two paire of compasses standing thus open, runne along the rumbs, one towards another, till the point which came from the place of your departure, and that other which came from the height of your graduation, meete: and where they meete, there is the place of your ship. And this point so found out, is most certain, when the height is carefully taken, and the rumbe knowne.

Chap. XXII.

Of the amending of the point of imagination.

HE that knoweth how to finde out the point by trauersing, shall easily amend the point of imagination, when hauing taken his height, hee findeth the said point not to be good, and certaine. And heere is to bee noted, that when you saile east and west, and finde the point by imagination, this point cannot bee amended, but you must saile in doubt how many leagues you haue gone, vntill you fall with the land; because that sailing in that course neither the height of the pole, nor your distance from the æquinoctiall, doth any whit alter. But when you saile by any other rumbe, your point of imagination may bee amended, and the amendment thereof shall be so much the more certaine as the rumbe of your nauigation commeth neerer to the north or south, and by so much the more vncertaine as it commeth neerer to the east or west. This amendmẽt is made two maner of waies, namely,

namely, either by trauerſing, or by the amendment of north and ſouth, and eaſt and weſt; which ſecond amendment though it be a kinde of trauerſing, yet is it called by another name, to diſtinguiſh it from the firſt.

The amendment of the point of imagination by the trauerſe point.

When you will amend your point of imagination by trauerſing, you muſt ſet one foote of one paire of compaſſes in the point found by imagination, and the other foote vpon the next rumbe by which you haue ſailed: and ſetting the foote of an other paire of compaſſes in the line of graduation vpon the number of degrees, which you finde your ſelfe diſtant from the æquinoctiall, and the other foote vpon the next eaſt and weſt line; runne with your compaſſes ſo opened by the foreſaid rumbes, till the point proceeding from the graduation, and the other which proceedeth from the point of imagination doe meete iuſt together, and then you may ſay that your point of imagination is mended by trauerſing.

The amendment of the point of imagination by North, South, Eaſt, Weſt.

The amendment by north, ſouth, eaſt, weſt, is after this manner: Set the foote of one compaſſe vpon the point found by imagination, and the other foote vpon the next north and ſouth rumbe: then place

place one foote of another compaſſe in the line of graduation vpon the degree wherein you find your ſelfe, and the other vpon the next eaſt and weſt rumbe, and ſo let theſe two compaſſes runne thus open by their rumbs, till the point which commeth from the point of imagination, and the other which commeth from the graduation doe meete; for then is your point of imagination amended by the amendment of eaſt, weſt, north, ſouth.

Of theſe two amendments the firſt ſerueth when you faile in a large gulfe, becauſe you may runne at libertie with the compaſſe: the ſecond ſerueth neere vnto any coaſt.

Chap. XXIII.

The point by imagination and the height.

When you faile by the ſixth or ſeuenth rumbe, that is, by the eaſt and by north, or eaſt and by ſouth, or by the weſt and by north, or weſt and by ſouth: or elſe by the eaſt northeaſt, or weſt ſouthweſt, or by the eaſt ſoutheaſt, or weſt northweſt; there is a certaine difficultie which may breed great error in finding the trauerſe point, notwithſtanding the latitude be taken, by reaſon of the rudder that guideth the ſhip, which giueth certaine yawes out of the courſe that the Pilot pretendeth, or by reaſon of the winde which bloweth not right in the pup, but maketh the ſhip fall to the leeward, from the direct and true courſe which it ought to keep. Wherefore becauſe in ſuch a caſe, if you finde your point by

by trauerſing, ſuppoſe by eaſt and by north, the way which I thinke is made and hath been ſailed may be by the eaſt northeaſt: which point ſo found, muſt ſtand more forward then the true point, by ſo much difference as there is betweene 42 and 88 Spaniſh leagues, which is 46 leagues, that is the difference of diſtance from the meridian or north and ſouth line in thoſe two points. In ſuch a caſe as this, it is not meete to find your point by trauerſing, to auoid the error which hereupon may enſue, which error ariſeth of ſuch a cauſe, as that a mans iudgement, be it neuer ſo good, cannot eaſily determine thereupon, and ſo conſequently he cannot iudge preciſely. But to auoid confuſion and cauſe of error, hee muſt caſt his point in manner following, and hee ſhall erre as little as is poſſible.

Let him examine according to the ordinary running of his ſhippe, how much way ſhe might make euery day that hee hath ſailed; and the leagues that ſhall amount in all the daies, let him take between the points of one compaſſe: and let him place one point thereof vpon the place from whence hee departed: and taking another compaſſe, let him ſet one point thereof vpon the graduation, according to the heigth which hee hath taken, and the other point vpon the next eaſt and weſt rumbe. Now let this compaſſe runne by his eaſt and weſt rumbe, till the point comming from the graduation meete with the ſecond point of the other compaſſe which hee holdeth not vpon the Chart: and in the place, where they meet, he may ſay that there is his point, and his ſhip.

And becauſe in this caſe all Pilots doe not vſe this point of imagination and height, there grow great diuerſities among them concerning their diſtance from land, when as in long voyages they conferre and communicate their opinions one with another; in ſo much that one according to his coniecture iudgeth himſelfe to be 50 leagues from land, another 100, another 200, and another thinketh hee is hard by the land. The reaſon is, becauſe ſome of them caſt their point by trauerſing, others by imagination only, and others by imagination and height, who are alwaies more certaine then the reſt.

Chap. XXIIII.

What it is to increaſe or diminiſh in height.

THe mariners call it increaſing in height when they go further and further from the æquinoctiall; and diminiſhing in height when they approch neerer to the æquinoctiall. So that in our nauigation wee either ſaile from a greater to a leſſe altitude of the pole, and then we goe towards the æquinoctial, and then the height is ſaid to be diminiſhed: or we ſaile from a leſſe to a greater height of the pole, and then we goe frō the æquinoctial, and are ſaid to increaſe our height. And hence it is that caſting our point by imagination, and afterwards (hauing taken the height) amending it by trauerſing, either the height wherein we finde our ſelues being taken by the Sun or ſtarre is greater, or elſe it is leſſe then that which wee made account of by imagination. And hence doe

doe ariſe foure rules: The firſt is, that when in ſailing wee doe increaſe the height, if the point amended by trauerſing be of greater height then the point of imagination, the ſhip hath gone more then the point of imagination ſhewed vs.

The ſecond: when we increaſe our height, if the point amended by trauerſing be in leſſe height then the point found by imagination, then hath the ſhip gone leſſe way then we imagined.

The third is, when we diminiſh our height in ſailing, if the point amended by trauerſing be in a greater height then the point found by imagination, then hath the ſhippe made leſſe way then we geſſed by our imagination.

The fourth is, when wee diminiſh our height, if the point amended by trauerſe bee in leſſe height then the point found by imagination, then hath the ſhip made more way then we imagined.

Chap. XXV.

How you may caſt a trauerſe point without Compaſſes.

IF a mariner chance to loſe his compaſſes, he may caſt his point of trauerſe after this maner: Let him take two ſlender threeds, and putting the end of one of them vpon the place from whence hee departed, let him ſtretch it in equall diſtance from the rumbe by which hee hath ſailed, and putting another threed in equall diſtance from the next eaſt and weſt rumbe, let him make it to paſſe by the degrees of height in which

he findeth himselfe; and where the two threeds crosse one another, there is the point of the ship: and alwaies the first threed (if it hath not changed the course) sheweth the way which the ship hath gone, and the second the parallel wherein the ship is.

Chap. XXVI.

Of another kind of casting a point by trauerse.

EXamine the difference of the degrees of distance from the æquinoctiall, which are betweene the place from whence the ship set foorth, and the place where the ship is: Then taking the heights of both places very precisely, and subtracting the lesser out of the greater, that which remaineth is the difference: which difference you must multiplie by the leagues, which answere to one degree in the rumb by which you haue sailed, and those leagues which the degrees and minutes of difference shall make, you shal take betweene the points of a paire of compasses out of your scale of leagues. And holding the said compasse so open, set one foote thereof vpon the point from whence the ship departed, and the other foote stretching towards the place whither the ship hath sailed, you must hold vp a little from the chart: and you must set one foote of the other compasse at the degree of the distance wherein your shippe is from the æquinoctial, when the said point is sought for, and the other point you must place vpon the next east and west parallel. And let this second compasse runne by his next east and west rumbe, vntill the

the point of the first compasse lifted vp, being set downe, that point of the second compasse which came from the said degree doth meete therewithal: and where those two points shall meete, there is the true point of the ship.

Chap. XXVIII.

Of the leagues which in nauigation answere to each degree of latitude in euery rumbe.

IF we suppose (as wee haue before said in the chap. of the quantitie of y earth) that the greatest circle thereof containeth in compasse 6300 commō Spanish leagues, then vntō euery degree of the meridian (which is the greatest circle) doe answere 17 Spanish leagues and an halfe: so that sailing north and south, if your heigth of the pole, or your distance from the æquinoctiall be varied one degree, you may say that you haue gone seuenteene leagues and an halfe: but if you varie one degree, and hold your course vpon the first point, then haue you sailed 17 leagues and $\frac{1}{10}$. And you haue declined from the meridian, or right line which passeth by the place from which you departed, three leagues and an half. And if you saile vpon the second point from the north or south till your heigth of the pole be changed one degree, you haue then gone 19 leagues and $\frac{1}{3}$, and are distant from your right line 7 leagues and $\frac{1}{14}$. And varying a degree vpon the third point of the Compasse from north or south, you haue gone 21 leagues, and are departed from your right line 11 leagues and $\frac{1}{2}$.

Sailing vpon the fourth point of the Compasse, there doe answere vnto euery degree 24 leagues and three fourths, and you are distãt from the right line or meridian 17 leagues and an halfe. Vpon the fifth point you must allow for one degree 31 leagues and an halfe, and then are you distant from your right line 26 leagues and $\frac{5}{7}$. Vpon the sixth point doe answere vnto one degree of latitude 45 leagues and $\frac{1}{4}$, and you are then parted from your right line 42 leagues and $\frac{1}{3}$. Vpon the seuenth point doe answere vnto one degree of latitude 89 leagues and $\frac{1}{4}$, and you are departed from your right line 88 leagues, as it appeareth out of the table following.

The table of the Author which is more precise.

Leagues of the course or rumbe.		*Distance from the right line.*	
1	17	$\frac{1}{4}$	3	$\frac{1}{5}$
2	19	$\frac{3}{8}$	7	$\frac{1}{4}$ $\frac{2}{3}$
3	21		11	$\frac{2}{3}$ $\frac{1}{2}$
4	24	$\frac{3}{4}$ $\frac{1}{2}$	17	$\frac{1}{2}$ $\frac{1}{5}$ $\frac{1}{4}$
5	31	$\frac{1}{2}$	26	$\frac{1}{5}$ $\frac{1}{4}$
6	45	$\frac{3}{4}$	42	$\frac{1}{4}$
7	89	$\frac{1}{4}$	88	

The old table which is lesse certaine.

Leagues of the course or rumbe.		*Distance from the right line or meridian.*	
18		3	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{2}{3}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$
19	$\frac{1}{2}$	7	
21	$\frac{1}{2}$	11	
25		17	
31	$\frac{1}{2}$ $\frac{1}{3}$	26	
46		42	
88		85	

Chap. XXVIII.

How you may come to know the longitude or the course from east to west.

That which the Cosmographers call longitude, is called by the mariners the distance from the right

right line, and the course of east and west, and the heigth of east and west, and it is a part of an east and west rumb contained betweene two meridians, one of which runneth by the point or place from whéce we departed, and the other by the point where the ship is. This distance from the right line is knowne by the meane of two things, namely of the course and of the difference of latitude, or of the course and distance.

The course and the difference of the heigth being giuen, you may know the said distance by trauerse or by numbers. By geometrie, or trauerse it is knowne in manner following: The heigth, or the distance of your ship from the æquinoctiall being knowne, and the rumbe also vpon which you haue sailed, you must cast vpon your chart a point by trauerse, and placing vpon that point one of the points of your compasses, and the other vpon the next rumbe of east and west; you must place one point of another paire of compasses at the hauen or point from whence the ship departed, and the other point vpon the north and south rumbe which is next. These two compasses thus opened, running by their rumbes one towards another, you must marke where the two points meete; namely, that which came out of the part from whence you departed, and that which you remoued from the point where the ship presently is, being found by trauerse: and where those two points doe meete, there make another point or prick. Then looke how many leagues there are from the said third point to the point of trauerse where the ship is, (both which doe alwaies

beare east and west one from another) so many leagues is your distance from the right line. And if in stead of the leagues set downe in the scale wee measure with degrees taken out of the graduation, *we shall haue the degrees of longitude, which are between the point of our departure, and the point of the place where presently we are.*

* This for the most part is not true in the ordinary Sea-chart.

And it is to be noted, that alwaies when we saile, wee either alter our latitude only, and that is when we saile north and south, or wee alter the longitude only, that is, when we saile by the self same latitude, going alwaies east and west by the same parallel: or we alter both latitude and longitude, when we saile by any of the other 28 windes. When wee alter the latitude only we swarue not one iot from the right line or meridian; when wee alter both longitude and latitude, then must wee finde the longitude or distance from the right line in manner aboue said.

But when your longitude only is altered, because then you must finde out the point where the ship is by imagination only, there is no certaine manner to know the longitude or distance from the right line, but only little more or lesse, setting downe a point by imagination, and measuring by leagues, or by degrees, what distance there is betweene that, and the point from which the ship departed. By numbers you may finde out the longitude in manner following: The difference of your distance from the æquinoctiall being knowne, which is so many degrees more or lesse, as you haue increased or diminished in the heigth of the pole, looke in the table annexed to the chapter next before this, for the leagues of

distance

distance from the right line which answer vnto one degree by the rumbe or point of the compasse vpon which you haue sailed; and multiplying those leagues by the number of degrees which you haue increased or diminished in the heigth of the pole in your nauigation, you shall then see how many leagues you are distant from the right line, which passeth by the place from whence you came; which leagues if you diuide by 17½, then will appeare vnto you the degrees of longitude betweene the place from whence you departed, and the point where you are.

Chap. XXIX.

How you may set downe in your Chart a new land neuer before discouered.

IT may sometimes fall out in new discoueries, or when your ship by meanes of a tempest is driuen out of her right course, that you shall come to the sight of some ile, shoald, or new land, whereof the mariner is vtterly ignorant. And to make some relation of the same, or to goe vnto it some other time, if you desire to set it downe in your Sea-chart, in the true place, you may doe it after this manner: So soone as you haue sight thereof, marke it well first with your compasse, obseruing diligently vpon which point therof it lieth. And secondly you must there take the heigth of the Sun or of the pole starre, that you may know in what point your ship is, and that point you must call the first point; which being so

ſo done, your ſhippe may ſaile on her courſe all that day, till the day following, without loſing her way: and the next day marke the land againe, and ſee vpon what point it lieth, and then take your heigth, and with it caſt your point of trauerſe once againe; and that you may call your ſecond point. Then take a paire of compaſſes, and placing one foote vpon the firſt point, and the other vpon the rumbe towards which the land did beare, when you caſt your firſt point: ſet alſo one foote of another paire of compaſſes in the ſecond point, and the other foote vpon the rumbe vpon which the land lay when you caſt your ſecond point; and theſe two compaſſes thus opened, you muſt moue by their rumbes, till thoſe two feete of both compaſſes doe meete together, which were moued from the foreſaid two points: and where they doe ſo meete together, there may you ſay is the land which you diſcouered; which land you may point out with the inlets and out-lets, or capes and other ſignes, which you ſaw thereupon. And by the graduation you may ſee the latitude thereof, that thereby you may finde it, if at any time after you goe to ſeeke for it.

Chap. XXX.

Seeing two knowne points or Capes of land as you ſaile along, how you may know the diſtance of your ſhip from them.

IT is the cuſtome of paſſengers, when they firſt deſcrie that land which they would arriue at, to aske the Pilot how farre they are from land. Vnto which queſtion hee may well anſwere,

ſwere, if hee know two capes, or points, or notable places thereupon : which places the further they be aſunder one from another, the more certainly may he anſwere to that queſtion.

Let him pitch therefore one foote of one paire of compaſſes vpon one of the two foreſaid capes, and the other foote vpon the rumbe which in his compaſſe pointeth towards that cape. And in like manner ſhall he doe with another paire of compaſſes, placing one foot thereof vpon the other knowne cape, and the other foote vpon the rumbe which ſtretcheth towards the ſaid ſecond cape. And mouing the two compaſſes ſo opened by their two rumbs off from the land, the very ſame point where the two feete which came from the two capes doe meete, you may affirme to be the very point where your ſhip is. And then taking meaſure by the ſcale of leagues, you may ſee what diſtance there is from the ſaid point to either of the foreſaid capes, or to any other place, which you thinke good, for it is a very eaſie matter if you know the point where your ſhip is.

Chap. XXXI.

Of the account of the Moone.

THe account of the Moone and of the tides is moſt neceſſarie to bee knowne of mariners, to enter and depart from any hauens, riuers, or barres, and to paſſe by ſome bankes, and ſhoalds.

A tide is a regular motion of the ſea, whereby at ſome

some times it seemeth more increased then at other: And these tides are of two sorts: for some are such as we call spring-tides and neap-tides, and the course of this motion hapneth from one halfe moneth to another halfe moneth. Others be those which wee call more properly by the names of tides, to wit, a full sea, and a low sea, a swelling and a falling sea; and these are from the one halfe lunar day, to the other halfe. Which tides, as well the first as the second, haue their course and mouing from the motion of the Moone: which is of two sorts; one proper from west to east, by meanes whereof in thirtie daies almost, it is in coniunction with the Sun, which we call the new moone; and in oppositon, which wee call the full of the moone; and those wee name the quarters, when it shineth halfe vnto vs. The other motion is from east to west by the force of the *Primum mobile*, or the first moueable heauen, whereby in one lunar day the Moone passeth ouer all the two and thirtie points of the Compasse, or to speak more plainly, it riseth and setteth, and returneth againe to arise. Which two motions of the Moone being knowne, we may easily discerne the maner of both kindes of the foresaid tides. And because that to the knowledge hereof it is requisite that wee know the middle motion of the Moone; I will first set downe how it may be knowne, and then how thereby wee may discerne the seasons of the tides.

For which purpose, wee are to note that the golden number, as it is commonly called, is a certaine number of yeeres, wherein the Moone hath all the diuersities of aspects with the Sunne that can happen

pen betweene them, which is done in euery nineteene yeeres almoſt.

As for example, if in the yeere 1588 there be a coniunction of the Sunne and Moone vpon the 26 of April, or an oppoſition vpon the 11 of April, I ſay that there ſhal not happen a coniunction of the Sun and Moone vpon the 26 of April, nor an oppoſition vpon the 11 of April till 19 yeeres be expired, which will be in the yeere of our Lord 1607. And ſo are wee to conceiue likewiſe of the quarters and other aſpects.

The ſecond thing to be noted, is, that from this golden number ſpringeth another, which is called the concurrent, being the daies of the Moone at the beginning of the yeere: which yeere, according to that account, beginneth from the laſt of Februarie, about twelue a clock at night, which is the beginning of March. And the daies of the Moone which then remaine, beſides all the whole lunare moneths of the yeere paſt are called by Calculators *The concurrents*; becauſe they ſerue to know the account of the Moone, throughout the whole yeere that is to come; and they concurre with other numbers to know the age of the Moone. Now by theſe two numbers, to bee able to diſcerne the daies of the Moone, or the diſtance thereof from the Sunne, you are to note the rules following.

The firſt rule of the golden number.

From the preſent yeere of our Lord you muſt deduct 1500, and out of the remainder, taking one in euery

euery twentie, we ſhall finde the golden number, if they be iuſt twenties. But if they be not iuſt twenties; aboue the number of twenties wee muſt adde that which remaineth aboue the twenties: al which being added together, if it exceed not nineteene, ſhall be the golden number. But if it exceed nineteene, caſt away nineteene, and the remainder is the golden number.

The ſecond rule of the concurrent.

Diuide the golden number by three, and if there remaine one, the concurrent is equall with the golden number; and if there remaine two, the concurrent is greater then the golden number by ten: but if nothing remaine, the concurrent exceedeth the golden number by twentie. And if this concurrent exceed the number of thirtie, then the remainder or ſurpluſſage ſhall be the concurrent.

The third rule of the coniunction.

The number of the concurrent being knowne, you muſt adde it vnto the number of moneths, which haue paſſed from the beginning of March laſt paſt, till the end of that moneth wherein you would know the ſame: and if the whole product amounteth not to thirtie, marke how much it wanteth of thirtie: and if it exceedeth thirtie, ſee what it lacketh of ſixtie, and that which it wanteth either of thirtie or ſixtie, is the number of the daies of ſuch a moneth wherein the coniunction hapneth.

The

The fourth rule, of the full and quarters of the Moone.

If the day of the coniunction be before the 15 day of the moneth, adde 15 vnto the day of the coniunction, and you ſhall finde the day of the full Moone; and if the coniunction happen after the 15 day, take away 15 from the number of the day of the coniunction, and you ſhall haue the full Moone of that moneth.

The firſt quarter is ſeuen daies after the coniunction, and the laſt quarter ſeuen daies after the full Moone.

The fifth rule, of the ſpring-tides, and neap-tides.

Vpon the day of the coniunction, and of the full Moone, are the ſpring-tides, and vpon the two quarter daies are the neap-tides: and ſo much the more doe the waters increaſe, as the coniunction or full Moone are neerer: and ſo much the more they decreaſe alſo, the neerer they come vnto the quarters.

An example whereby the foreſaid rules are made more plaine.

Suppoſe a fleete of ſhips lie within the hauen of *San Lucar de barrameda*, expecting a fit time to paſſe ouer the barre towards the Indies. It is euident, that if the ſhips be great, they haue need of much water to paſſe the banke, or the barre: which quantitie of water

water is only in the ſpring-tides. And becauſe they are twice in one moneth, namely in the coniunction and in the full of the Moone, I deſire to know when the ſpring-tides and neap-tides of the moneth of Iune in the yeere 1588 were to bee expected, in which moneth I preſuppoſe the fleete was to depart. Firſt therefore I caſt away 1500, and out of the 88 remaining I take from each 20, one, which make foure in all; which being added to the 8 that ſurmount 80, they make the golden number to be 12, according to the firſt rule. I diuide theſe twelue by three, and the quotient is foure, and nothing remaineth; and becauſe there is no remainder, I will take two more of the concurrent then of the golden number, and there ſhall be two of the concurrent, caſting away thirtie, by the ſecond rule. Adding theſe two to the foure moneths which are from the beginning of March paſt till this preſent moneth of Iune, I finde that they make ſixe. And becauſe ſixe want twentie foure to make vp thirtie, I ſay that in the yeere 1588 we had a coniunction of the Moone vpon the 24 of Iune, by the third rule, and adding ſeuen vnto the day of this coniunction, you haue the firſt of Iuly, which is the day of the firſt quarter. And taking away 15 from 24, being the number of the coniunction day, there remaine nine, and vpon that day of the moneth you haue the full Moone. And adding other ſeuen vnto the nine daies of the full Moone, you haue the laſt quarter vpon the ſixteenth of Iune by the fourth rule. I ſay therefore that the ſpring-tides or greateſt waters of the moneth of Iune, were in that yeere vpon the ninth, and foure

These daies mentioned in this example, are to be vnderſtood according to the new Romane Gregorian Kalendar, which goeth alwaies tenne daies before ours vſed in England.

foure and twentieth daies of Iune; and the neap-tides, or lesse waters were vpon the sixteenth day of Iune, and the first of Iuly by the fifth rule.

Chap. XXXII.

Of the daily Tides.

NOw that wee know the rules of the spring-tides and neap-tides, let vs say somewhat of the tides that happen euery day, which depend vpon another swift motion of the Moone, whereby turning round about the world from East to West, it passeth euery day by the 32 points of the Compasse: and this daily motion of the sea, falleth not euery day at the same houre, because the Moon doth not alwaies keepe one and the same distance from the Sun. For the Moone moueth almost thirteene degrees of her proper motion in one naturall day, whereas the Sunne moueth scarce one: and so one being taken from thirteene, there remaine 12. And because the Sun doth giue, and marke out vnto vs houres, and the Moone tides, it commeth to passe that an houre being that space of time wherein fifteene degrees of the æquinoctiall passe by euery point of the Compasse, the part by which the Moon is distant from the Sunne shall be twelue degrees, which twelue are $\frac{4}{5}$ of fifteene degrees contained in each houre. Insomuch that the Moone by her middle motion is euery day distant from the Sun about twelue degrees; which being reduced vnto time, doe make $\frac{4}{5}$ parts of an houre, whereby the Moone is euery day slower then the Sun, in comming to each

point of the heauens by the motion from East to West, in regard of that which she hath borrowed for her owne proper motion from West to East. Whereof it commeth to passe, that so many daies as the Moone is old, so many times $\frac{4}{7}$ parts of an houre is it slower then the Sun in passing by each rumbe, vntill the day of their coniunction, when as they passe both by the same rumbe, in one and the same houre. And so accordingly, because wee are to set downe the certaine houre of euery day wherein the tide happeneth, wee must diligently obserue the rules following.

The first rule.

In diuers parts of the sea coast, the Moone maketh a full sea euery day, being in diuers rumbes, according to the disposition of the land. But vpon all the coast of Spaine in the Ocean, it is full sea when the Moone is in the northeast and southwest.

The second rule.

Vpon the day of the coniunction and full moone, you haue a full sea at three a clock in the morning, and at three in the afternoone; for at those houres the Moone goeth with the Sun at the northeast and at the southwest. But vpon other daies of the moon, the full sea falleth out at the same houre when the Moone commeth to those two points; which is knowne by counting the age of the Moone.

The third rule.

That you may know at all times how many daies old the Moone is, you must adde three numbers together; to wit, the concurrent, and the moneths from the beginning of March to the moneth present, and the daies of the moneth wherein you would know this: and if the whole product exceedeth not thirtie, it containeth iust the daies of the Moone; but if it doth exceed thirtie, the surplussage sheweth the daies of the Moones age.

The fourth rule.

Multiplie the daies of the Moones age by foure, and diuide the product by fiue, and the remainder after diuision containeth the houres whereby the Moone commeth more slowly then the Sunne, to the northeast or southwest, or to that rumbe wherein it maketh a full sea: which houres shall be added to the three houres of the morning, and then you haue the houres of the first tide or of the full and swelling sea; and six houres and almost a quarter after, commeth the first ebbe, or low water, and 12 houres and $\frac{2}{7}$ after the first full sea, commeth the second tide: and other six houres and $\frac{1}{7}$ after the second tide, commeth the second ebbe.

The fifth rule.

When the daies of the Moones age are lesse then fifteene, we may make by them our account for the

tides: but if they exceed fifteene, we must make our account by the surplusage.

An example of the said rules.

Vpon the 29 of Iuly 1588, I desired to know the houres of the full sea and of the ebbe; to make choice of that which might seeme most expedient for my voyage. By the former example I finde that the golden number of this yeere is 12, and the concurrent 2, according to the correction of the yeere by Pope *Gregorie* the 13. Then I adde this number of 2 to the number of 5 moneths, which haue passed from the beginning of March, and the 29 daies of the moneth of Iuly, all which 3 numbers make 36; then I cast away 30, and there remaine six daies for the age of the Moone: and because they exceed not fifteene, I multiply them by $\frac{4}{5}$ of an houre, according to the fourth rule, and they make $\frac{24}{5}$. I diuide these 24 by 5, and I finde the quotient to be foure, and the remainder foure. And so I say that ỹ Moone commeth to the northeast foure houres and $\frac{4}{5}$ later then the Sunne. And because the Sunne commeth to the northeast at three a clock in the morning, I adde those foure houres and $\frac{4}{5}$ vnto the three houres last mentioned, and they make seuen houres and $\frac{4}{5}$, which is the houre of the morning wherein the tide or full sea happeneth. And adding vnto these seuen houres and $\frac{4}{5}$ other six houres and $\frac{1}{5}$, they make in all foureteene houres, which falleth out at two a clock in the afternoone, which is the houre of the first low water or ebbe. And adding vnto the said houre of the full sea twelue houres and $\frac{3}{5}$, it will amount vnto

eight

eight of the clock and $\frac{1}{7}$ part of an houre, which is the houre of the night wherein the second tide or high water was. And adde vnto this second tide other six houres and $\frac{1}{7}$, and they make two of the clocke in the morning and $\frac{2}{7}$, at which time there commeth the second ebbe or low sea.

Chap. XXXIII.

Of a certaine instrument, whereby you may in generall iudge of the tides.

BEcause the tides (it being supposed that in all places they proceed from the motion of the Moone) runne not in euery part of the world by one and the same rumbe, as it is manifest in the channell of *Flanders*, and in all the coasts of the northerne sea, which is a matter of great confusion and difficultie to mariners: I thought good heere to set downe an instrument, whereby (the daies of the Moone and the rumbe, whereupon the Moone causeth the tide in euery part, being knowne) they may iudge of the ebbe and flood with great facilitie.

Draw vpon a sheete of paper, or vpon a plate of tinne, or any other matter, a circle as bigge as the palme of a mans hand; and halfe a fingers breadth within that circle draw another circle; and hauing diuided them both into 32 equall parts, with lines drawne from the center to the circumference of the greater circle, vpon the vpper end of one of those lines, place a flower de-lis, and the number of 12, and in the next line thereunto toward the left hand, set

downe 12 and ¾, and in the third line 1 ½, and ſo proceed forwards, putting downe vpon euery line following ¾ of an houre more, vntill you come againe to the number of 12 in the loweſt line. And from thence forwards ſet downe the ſame numbers that you did at the firſt.

Theſe 32 lines ſo drawne, doe repreſent the 32 windes, whereby the Sunne and Moone paſſe euery day. And ſo you may ſet downe the names of the principall windes, to the end that you may know them,

them, and those that are next them. And then in like manner make another round and slender table, as bigge as the innermost circle of those two which you drew in the first table: and diuiding it into thirtie equall parts, first into two by a line, diuiding it in the midst, and then either of those two into three, and euery of those three into fiue, these diuisions will represent the daies of the Moone. And leauing vpon 1 of those parts an index or small point, which may reach without the circle, set downe the numbers thereof, beginning with 30 in that part where that point endeth, and the number of 1 in the line following towards the left hand, and then 2, &c. till you end at the same point with 30. This being done, fasten with a threed or naile, the second table or circle vpon the center of the first, so that it may freely without impediment turne round about.

The vse of this Instrument.

The vse of this instrument is, that knowing in euery port or part of any coast, the rumbe or quarter on which the Moone maketh full sea, or high water, you must note vpon the outward circle of the windes that quarter or rumbe: and placing the tooth or point of the inner circle where the number of 30 is vpon that quarter or rumbe; make it there fast, putting a little wax vnderneath, that it may not moue. Then account the daies of the Moones age in the inner circle, and ouer against the end of your account you shall see in the vttermost circle the houre of the full sea of that day, together with the rumbe where the Sunne is at that houre. And at the

same houre when it is in the contrarie part, it will make a full sea. The place of the Moone at the houre of the tide, is alwaies either where the point is, or at the point right ouer against it, and hence you may easily finde both ebbes also. This little instrument, although it be but of small inuention, is of great vse and profit for the nauigations of *Flanders, France, England, Ireland,* and all the northerne regions, where you haue much varietie in the tides.

Chap. XXXIIII.

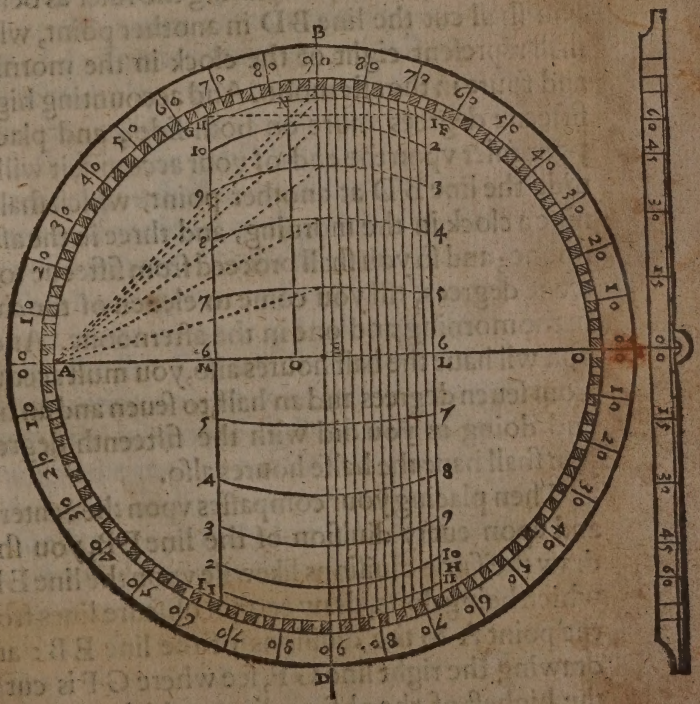
Of the making of an vniuersall Diall, which may serue generally all the world ouer.

DRaw vpon a table or pastboord the circle A B C D vpon the center E: and halfe a fingers breadth within that circle, vpon the same center draw another circle: and about the breadth of a wheate corne within the second circle, draw a third; and placing your ruler vpon the center E, by the right line A C diuide the two inner circles in the midst A B C, and C D A in the points B D, vpon which, and vpon the center E the ruler being placed, you may draw the line B D, whereby euery one of the foresaid cireles shall be diuided into foure equall parts. And diuiding euery one of those foure quadrants of the inner circle, to wit, A B, B C, C D, D A into 90 parts (as the manner is in the making of an Astrolabe) set numbers thereto from 5 to 5, beginning your account from the two points A C, and so proceeding both waies till you end your account in 90, at the points B D;

and

and this inner circle thus diuided, repreſenteth the meridian.

And the point C is the north, A the ſouth, and the points B D are thoſe where the æquinoctial cutteth the meridian. Then count 23 degrees and an halfe from the point B to F, and to G on both ſides. And ſo much account alſo from the point D to H and to I. And then drawing two right lines F H and G I, the line F H ſhall repreſent the tropick of *Cancer*, and G I the tropick of *Capricorne*. And thoſe two



lines

lines shall cut the line C A, (which is the axtree of the world, and the circle of six of the clock in the morning and euening) vpon the points L M. Then count fifteene degrees from C towards B, and other fifteene from A towards B, and placing your ruler on either side vpon the end of your account, you shall cut the æquinoctial B D vpon a certaine point, which shall represent vnto you seuen a clock in the morning, and fiue of the clock at euening. And counting other fifteene degrees on both sides, more towards the point B, and placing the ruler as before, you shall cut the line B D in another point, which shall represent eight of the clock in the morning, and foure in the afternoon. And accounting higher fifteene degrees more on both sides, and placing your ruler vpon the end of your account, it will diuide the line B D at another point, which shall be nine a clock in the morning, and three in the afternoone; and so you shall proceed from fifteene to fifteene degrees, till you come to eleuen of the clock in the morning, and one in the afternoone. And if you wil haue the half houres also, you must account from seuen degrees and an half, to seuen and an half; and doing as you did with the fifteenth degrees, you shall haue the halfe houres also.

Then placing your compasses vpon the center E, and vpon euery diuision of the line E B, you shall draw the same diuisions likewise vpon the line E D; which being done, draw certain obscure lines from the point A to the diuisions of the line E B: and drawing the right line G F, see where G F is cut at the highest of the obscure lines, which must be at

the

the point N, from whence the line N O is to bee drawne equally diſtant from the line B E. And this line N O ſhall be diuided proportionally by the obſcure lines, euen as the line B E. Then let the diuiſions of the line N O be transferred into the lines M G, M I, L F, L H, and then the tropicks alſo ſhall be diuided. Then by euery three points anſwerable in the æquinoctiall, and the two tropicks, you ſhall draw certaine parts of circles, ſeeking the center of thoſe three points in the æquinoctiall line extended foorth on either ſide; and theſe parts of circles repreſent the houres: then make an account of the degr. of declination from the point B, and from D on both ſides by euery 2 degr. and draw lines parallel to the æquinoctiall from one to another; and thoſe ſhall be the parallels of the Suns declination. Moreouer, you ſhall make an horizon as large as the diameter of the inner circle, which ſhall be diuided after this manner: Count from the points A C towards B fiue degrees; and putting your ruler vpon the end of the account of both parts, ſee where it cutteth the line E B, and there make a marke: and then counting on both ſides other fiue degrees, and putting the ruler once againe at the end of your account, make another mark where it cutteth the line E B. And ſo the line E B muſt be diuided from fiue to fiue degrees; which diuiſions ſhall be remoued into the ſaid horizon, faſtning it to the center, and laying it to the line B D, and diuiding it both waies as the line E B is diuided; and ſet numbers therein-to from 5 to 5, which may begin in the midſt, and end with 90 at the ends of the Horizon, and let euerie

rie one of these parts be diuided into fiue other parts or degrees. Then accounting from the center E in the Horizon eleuen degrees and $\frac{1}{4}$, you shall set there a mark, which shall be the seuenth point from north and South, that is, it shall represent the points which are next to the East and West in the Compasse. And accounting other eleuen degrees and a quarter, and making there a marke, it shall represent the sixth point from North and South. And so you must doe with the other points, and then your instrument is finished.

Chap. XXXV.

Of the parts of this instrument.

IN this instrument, the first thing is a circle diuided into 360 degrees, which is the meridian and the line of twelue a clock. The second are the right lines, of which that in the midst is the æquinoctiall, and the two others are the tropicks of *Cancer* and *Capricorne*. And the other lines betweene those, are the parallels of the Suns declination, which haue their numbers agreeable to them. And those that are betweene the æquinoctiall, and the tropick of *Cancer*, doe serue from the 11 of March to the 13 of September, and the others for the residue of the yeere. The crooked lines which crosse those parallels are the houre lines. And the point of the meridian, which is 90 degrees distant from the æquinoctiall, towards the left hand, is the north pole: and the point opposite to that, is the south pole. In the Horizon there are first the degrees, and then the points of

of the Compasse distinguished by the small pricked lines.

Chap. XXXVI.

How you may know what a clock it is by this Instrument.

AT any time of the day, when you would know what a clock it is, take ỹ heigth of the Sun with your Astrolable, and seek in the table of the Sunnes declination, what declination it hath the same day, & the height of the pole, which a good mariner knoweth at all times, because hee must direct his course thereby. This being knowne, place the horizon of the instrument on the one side vnder the north, and on the other side aboue the south, so many degrees as his distance from the æquinoctiall is the same day: and fastē it there with a little wax that it may not moue. Then count in the meridian on either side from the horizon (which now standeth firme) the height of the Sunne aboue the horizon, taken with your Astrolabe: and by the end of the account, draw a line or threed ouerthwart, which shall be equally distant from the horizon. Then reckon the Suns declination in the parallels, beginning from the æquinoctiall of the instrument that way which the Sun declineth, and marke the line or parallel, at which the account of the declination endeth; where and at what houre it is crossed by the threed, for that houre is the houre of the day. But note this, that if the crossing of the threed and parallel doe fall vpon the

the diuision of the parallel and of the houre, it is a iust houre; but if it fall beside the common meeting of the parallel and of the houre-line vpon that side where it falleth, see how much more there is then an houre, whether $\frac{1}{4}$, or $\frac{1}{3}$, or $\frac{1}{2}$, &c. Now although euery houre line hath two numbers, one of the morning and another of the afternoone, yet it is an easie matter to distinguish which of them will serue your turne, if you know whether your obseruation be before high noone or after; which is to bee knowne by your Astrolabe: for if the Sun ascend, it is before noone; but if it descend, it is afternoon.

Chap. XXXVII.

Of the variation of the Compasse, by this instrument.

IF you would know by this instrument the variation of the Compasse, you must doe thus: When the Sunne riseth or goeth downe at the horizon, obserue him with your compasse, noting very diligently vpon what rumbe and part of the rumbe he riseth or falleth. And if the compasse be diuided into 360 parts, beginning to reckon them from the East and from the West on either side, and ending in the North and South with 90 degrees, it shall be the fitter for this purpose, because then you shall see the very degree of the compasse vpon which the Sunne riseth or setteth. Then the horizon being set fast (as wee haue shewed in the former chapter) marke in the instrument by which part or degree of those vpon the

the horizon, the parallel of the Sunnes declination that day doth crosse the same: counting in the numbers of the horizon from the center towards the North pole, if it be from the 11 of March to the 13 of September; or towards the South pole, the other halfe of the yeere: And marke also whether this crossing be so many degrees distant from the diuision of the æquinoctiall of your instrument, as the Sunne in his rising was distant from the east of the Compasse, or at his going downe was distant from the west thereof; for then you may say that the Compasse hath no variation at all. But if it be not so, marke the rules following:

1 When the Sunne riseth by the same rumbe of the Compasse which the instrument doth shew, the Compasse hath no variation at all.

2 When the Sunne riseth more to the North of the Compasse, or goeth downe more to the South, then is shewed by the instrument, all the difference betweene the instrument and the Compasse is the northeasting, or variation thereof to the eastward.

3 If the Sunne riseth more to the South of the Compasse, or setteth more to the North then the instrument sheweth, all the difference betweene the instrument and the Compasse is the northwesting, or westerly variation thereof.

Chap. XXXVIII.

At what houre the Sunne riseth and setteth euery day, in all parts of the world.

THe height of the pole in that part where you desire to know this; being knowne, place the Horizon

Horizon in such sort as was shewed in the 36 chapter: And finding by the table of the Sunnes declinations the declination which the Sunne hath that day, count the same from the æquinoctial of the instrument towards that part whither the Sunne declineth among the parallels, and then marke the parallel whereat your account endeth, in what houre, and in what part of the houre it cutteth the Horizon; noting that euery houre hath two numbers, one afternoone, which is the houre of the Suns setting; and another before noone, which is that wherin the Sunne riseth.

Chap. XXXIX.

Of the length of the day and of the night.

THe houre of the Suns going downe being knowne, double it, and the double number of houres will shew you the length of the day. Also the houre of the Sunnes rising being knowne, and doubled, will manifest vnto you the length of the night, in that part of the yeere when you desire to know the same.

Chap. XL.

Of a night-diall by the North.

THat being knowne which is before declared of the situation of the North starre and of the guards, wee may easily know in the night what a clock it is, whersoeuer wee can see the north

north starres: presupposing that vpon the 15 of Aprill at the very point of midnight, the former guard goeth a-head in respect of the north starre. And because by this account of the houre of the night, wee must take for a beginning, the very instant when the former guard maketh midnight; the rule following is to be obserued.

The rule.

The number of the whole moneths which haue passed since the 15 of April forward being doubled, you haue the number of the houre wherein the former guard maketh midnight, being head-most: and if the moneths fall not out iust, adde for euery fifteene daies, aboue the whole moneths, one day, and for euery day foure minutes, and you shall know when it is midnight.

As for example.

If I would know vpon the 15 of Nouember, where the former guard maketh midnight, I account the whole moneths from the 15 of April, and I finde them to be seuen: which being doubled, make foureteene. I say therefore, that vpon the 15 of Nouember, it shall be midnight, when the former guard hath passed before the north or head foureteene houres. And so allowing three to the northwest, three to the west, and six to the foote, it may be said that the former guard going two houres before the foote towards the southwest, that it is midnight, which shall come to passe when the former guard goeth an houre before from the southwest. This be-

ing thus preſuppoſed, when I would know in the night what a clock it is, I muſt note two things: the one is, in what part the former guard maketh midnight the ſame night. The ſecond is, in what part the ſaid guard is at the ſame inſtant, when I would know the time of the night; which being vnderſtood, I will make mine account from that which the guard wanteth of being come to the place where that day it maketh midnight; or from ſo much as it hath paſſed the ſame place, making mine account that one third part of foure points of the Compaſſe is an houre, and that which it wanteth of being come, or which it hath paſſed forward, are the houres before midnight, if it be not come to the place; or after midnight, if it haue gone beyond.

As for example.

I ſee the former guard in the northweſt vpon the 15 of Iuly; becauſe that vpon the 15 of Iuly, by the account before mentioned, the former guard maketh midnight in the weſt: and from the north or head to the weſt, are ſix houres; and from the northweſt, where I ſaw the guard, to the weſt, where it maketh midnight, are three houres: I ſay therefore that it is three houres before midnight; that is to ſay, nine of the clock at night.

FINIS.

BEcauſe the tables of the Sunnes declination that haue bin moſt in vſe amongſt Engliſh ſea-men, doe both in faſhion and manner of vſing ſomething differ from thoſe before ſet downe, pag. 393, 394, &c. Leſt any therefore of the meaner ſort might be miſtaken, or ſhould not rightly conceiue the manner of vſing theſe tables; I thought good to adioyne theſe alſo heere following, bearing in a manner the ſame forme and ſhape, and therefore alſo to be vſed altogether almoſt in the ſame ſort that thoſe tables haue been, which for theſe many yeeres haue been moſt vſed by Engliſh mariners.

This table of the Sunnes declination containeth twelue particular tables, ſhewing the declinations of the Sunne for euery day of the twelue moneths of the yeere for foure yeeres together, from leap yeere to leape yeere. In the head of euery one of theſe tables is firſt ſet downe the moneth for which that table is made. Vnder this are placed the yeeres of our Lord, for which thoſe tables may ſerue: which yeeres are diuided into foure rankes, ſignified by the foure arithmeticall characters 1, 2, 3, 4, that are ſet ouer them. The firſt ranke containeth the firſt yeeres immediatly following after the leape yeere: the next ranke containeth the ſecond yeeres after the leape yeere. In the third ranke are ſet downe the yeeres that follow three yeeres after the leap yeere: and in the fourth and laſt rank are the fourth yeeres after the precedent leap yeeres, which are alſo leap-yeeres themſelues.

Vnder euery one of theſe rankes of yeeres there

are two columnes; the first whereof containeth the degrees and min. of the Sunnes declination, answerable to euery day of the moneth, superscribed in each of those yeeres, without sensible error. In the second columne are set downe the minutes of the differences of the Suns declinations for euery one of those daies, for the readier finding of the part proportionall of this difference, answering to any difference of longitude from London, whereof you may reade more pag. 423, &c. In the first columne of each of these tables next the left hand are placed the numbers of the daies of the moneth that is set downe in the head thereof. The vse of this table for knowing the declination of the Sunne at any time is thus: Looke the moneth and yeere wherein you would know the same in the head of the table, and the day of the moneth in the first columne next the left hand; then proceeding from that day directly in the same line towards the right hand, till you come right vnder the same yeere, you shall there finde the declination you sought for.

The vse of this table.

Take for example the 24 day of February in the yeere 1610. Finding therefore that moneth and yeere in the head of the table, and the 24 day in the first columne; in the same line proceeding towards the right hand, till you come right vnder that yeere; you haue there the Sunnes declination for that time 5 degrees, 34 minutes towards the South.

South declination.

Ianuary.

	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
Day.	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*
1	21	47	10	21	50	10	21	52	10	21	54	9
2	21	37	10	21	40	10	21	42	10	21	45	10
3	21	27	10	21	30	11	21	32	10	21	35	11
4	21	17	11	21	19	11	21	22	11	21	24	11
5	21	6	12	21	8	11	21	11	11	21	13	11
6	20	54	12	20	57	12	21	0	12	21	2	11
7	20	42	12	20	45	12	20	48	12	20	51	12
8	20	30	13	20	33	13	20	36	13	20	39	13
9	20	17	13	20	20	13	20	23	13	20	26	13
10	20	4	14	20	7	13	20	10	13	20	13	13
11	19	50	14	19	54	14	19	57	14	20	0	13
12	19	36	14	19	40	14	19	43	14	19	47	14
13	19	22	14	19	26	15	19	29	14	19	33	15
14	19	8	15	19	11	15	19	15	15	19	18	14
15	18	53	15	18	56	15	19	0	15	19	4	15
16	18	38	16	18	41	15	18	45	15	18	49	16
17	18	22	16	18	26	16	18	30	16	18	33	15
18	18	6	16	18	10	16	18	14	16	18	18	16
19	17	50	17	17	54	17	17	58	17	18	2	17
20	17	33	17	17	37	16	17	41	16	17	45	16
21	17	16	17	17	21	17	17	25	17	17	29	17
22	16	59	17	17	4	18	17	8	18	17	12	17
23	16	42	18	16	46	17	16	50	17	16	55	18
24	16	24	18	16	29	18	16	33	18	16	37	18
25	16	6	18	16	11	19	16	15	18	16	19	18
26	15	48	19	15	52	18	15	57	19	16	1	18
27	15	29	19	15	34	19	15	38	18	15	43	19
28	15	10	19	15	15	19	15	20	19	15	24	19
29	14	51	19	14	56	19	15	1	20	15	5	19
30	14	32	19	14	37	20	14	41	19	14	46	19
31	14	13		14	17		14	22		14	27	

South declination.

South declination.

February.

Day.	1 1609 1613 1617			2 1610 1614 1618			3 1611 1615 1619			4 1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	13	53	20	13	58	20	14	2	20	14	7	20
2	13	33	21	13	38	21	13	42	20	13	47	20
3	13	12	20	13	17	20	13	22	20	13	27	21
4	12	52	21	12	57	21	13	2	21	13	6	20
5	12	31	21	12	36	20	12	41	20	12	46	20
6	12	10	21	12	16	21	12	21	21	12	26	21
7	11	49	21	11	55	22	12	0	22	12	5	21
8	11	28	21	11	33	21	11	38	21	11	44	22
9	11	7	22	11	12	22	11	17	21	11	22	21
10	10	45	22	10	50	22	10	56	22	11	1	22
11	10	23	22	10	28	21	10	34	22	10	39	22
12	10	1	22	10	7	22	10	12	22	10	17	22
13	9	39	22	9	45	22	9	50	22	9	55	22
14	9	17	22	9	23	22	9	28	22	9	33	22
15	8	55	23	9	0	23	9	6	22	9	11	22
16	8	32	22	8	38	22	8	43	23	8	49	22
17	8	10	23	8	15	23	8	21	22	8	26	23
18	7	47	23	7	53	22	7	58	23	8	4	22
19	7	24	23	7	30	23	7	35	23	7	41	23
20	7	1	23	7	7	23	7	12	23	7	18	23
21	6	38	23	6	44	23	6	49	23	6	55	23
22	6	15	23	6	21	23	6	26	23	6	32	23
23	5	52	23	5	58	23	6	3	23	6	9	23
24	5	29	23	5	34	24	5	40	23	5	46	23
25	5	5	24	5	11	23	5	17	23	5	22	24
26	4	42	23	4	48	23	4	53	24	4	59	23
27	4	18	24	4	24	24	4	30	23	4	36	23
28	3	55	23	4	1	23	4	6	24	4	12	24
29										3	49	23

South declination.

South declination.

North declination.

March.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	3	31	23	3	37	24	3	43	24	3	23	24
2	3	8	24	3	13	23	3	19	23	3	1	24
3	2	44	24	2	50	24	2	56	24	2	37	23
4	2	20	23	2	26	23	2	32	24	2	14	24
5	1	57	24	2	3	24	2	8	23	1	50	23
6	1	33	24	1	39	24	1	45	24	1	27	24
7	1	9	23	1	15	24	1	21	24	1	3	24
8	0	46	24	0	51	23	0	57	24	0	39	24
9	0	22	24	0	28	24	0	33	23	0	15	23
10	0	2	23	0	4	24	0	10	24	0	8	24
11	0	25	24	0	20	23	0	14	24	0	32	24
12	0	49	24	0	43	24	0	38	23	0	56	23
13	1	13	23	1	7	24	1	1	24	1	19	24
14	1	36	24	1	31	23	1	25	24	1	43	23
15	2	0	24	1	54	24	1	49	23	2	6	24
16	2	24	23	2	18	23	2	12	24	2	30	23
17	2	47	23	2	41	24	2	36	23	2	53	24
18	3	10	24	3	5	23	2	59	23	3	17	23
19	3	34	23	3	28	23	3	22	24	3	40	23
20	3	57	23	3	51	24	3	46	23	4	3	24
21	4	20	23	4	15	23	4	9	23	4	27	23
22	4	43	23	4	38	23	4	32	23	4	50	23
23	5	6	23	5	1	23	4	55	23	5	13	23
24	5	29	23	5	24	23	5	18	23	5	36	23
25	5	52	23	5	47	23	5	41	23	5	59	22
26	6	15	23	6	10	22	6	4	23	6	21	23
27	6	38	23	6	32	23	6	27	22	6	44	22
28	7	0	22	6	55	22	6	49	23	7	6	23
29	7	23	23	7	17	23	7	12	22	7	29	22
30	7	45	22	7	40	22	7	34	22	7	51	22
31	8	7	22	8	2		7	56		8	13	

South declination. North declination. South declination. Æquinoctiall. North declination.

Aprill.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	8	29		8	24		8	18		8	35	
2	8	51	22	8	46	22	8	40	22	8	57	22
3	9	13	22	9	8	22	9	2	22	9	19	22
4	9	34	21	9	29	21	9	24	22	9	40	21
5	9	56	22	9	51	22	9	46	22	10	2	22
6	10	17	21	10	12	21	10	7	21	10	23	21
7	10	38	21	10	33	21	10	28	21	10	44	21
8	10	59	21	10	54	21	10	49	21	11	5	21
9	11	20	21	11	15	21	11	10	21	11	26	21
10	11	41	21	11	36	21	11	31	21	11	46	20
11	12	1	20	11	56	20	11	51	20	12	6	20
12	12	21	20	12	16	20	12	11	20	12	26	20
13	12	41	20	12	36	20	12	31	20	12	46	20
14	13	1	20	12	56	20	12	51	20	13	6	20
15	13	20	19	13	16	20	13	10	19	13	26	20
16	13	40	20	13	35	19	13	30	20	13	45	19
17	13	59	19	13	54	19	13	50	20	14	4	19
18	14	18	19	14	13	19	14	9	19	14	23	19
19	14	36	18	14	32	19	14	27	18	14	41	18
20	14	55	19	14	50	18	14	46	19	15	0	19
21	15	13	18	15	9	19	15	4	18	15	18	18
22	15	31	18	15	27	18	15	22	18	15	36	18
23	15	49	18	15	44	17	15	40	18	15	53	17
24	16	6	17	16	2	18	15	58	18	16	11	18
25	16	23	17	16	19	17	16	15	17	16	28	17
26	16	40	17	16	36	17	16	32	17	16	45	17
27	16	57	17	16	53	17	16	49	17	17	1	16
28	17	13	16	17	9	16	17	5	16	17	17	16
29	17	29	16	17	25	16	17	21	16	17	33	16
30	17	45		17	41		17	37		17	49	

North declination.

North declination.

May.

	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
Day.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	18	0	15	17	57	15	17	53	15	18	4	15
2	18	15	15	18	12	15	18	8	15	18	19	15
3	18	30	15	18	27	14	18	23	15	18	34	15
4	18	45	14	18	41	15	18	38	14	18	49	14
5	18	59	14	18	56	14	18	52	14	19	3	14
6	19	13	14	19	10	13	19	6	14	19	17	13
7	19	27	13	19	23	14	19	20	14	19	30	13
8	19	40	13	19	37	13	19	34	13	19	43	13
9	19	53	12	19	50	12	19	47	12	19	56	13
10	20	5	13	20	2	13	19	59	13	20	9	12
11	20	18	12	20	15	12	20	12	12	20	21	12
12	20	30	11	20	27	11	20	24	12	20	33	11
13	20	41	11	20	38	12	20	36	11	20	44	11
14	20	52	11	20	50	11	20	47	11	20	55	11
15	21	3	11	21	1	10	20	58	11	21	6	11
16	21	14	10	21	11	11	21	9	10	21	17	10
17	21	24	10	21	22	10	21	19	10	21	27	9
18	21	34	9	21	32	9	21	29	10	21	36	10
19	21	43	9	21	41	9	21	39	9	21	46	9
20	21	52	9	21	50	9	21	48	9	21	55	8
21	22	1	8	21	59	8	21	57	8	22	3	8
22	22	9	8	22	7	8	22	5	8	22	11	8
23	22	17	8	22	15	8	22	13	8	22	19	8
24	22	25	7	22	23	7	22	21	7	22	27	7
25	22	32	6	22	30	7	22	28	7	22	34	6
26	22	38	7	22	37	6	22	35	7	22	40	6
27	22	45	6	22	43	6	22	42	6	22	46	6
28	22	51	5	22	49	6	22	48	6	22	52	6
29	22	56	5	22	55	5	22	54	6	22	58	5
30	23	1	5	23	0	5	22	59	5	23	3	5
31	23	6		23	5		23	4	5	23	8	

North declination.

North declination.

Iune.

	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
Day.	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*
1	23	10	4	23	10	4	23	8	4	23	12	4
2	23	14	4	23	14	3	23	12	4	23	16	3
3	23	18	3	23	17	3	23	16	4	23	19	3
4	23	21	3	23	20	3	23	20	3	23	22	3
5	23	24	2	23	23	3	23	23	2	23	25	2
6	23	26	2	23	26	2	23	25	2	23	27	2
7	23	28	2	23	28	1	23	27	2	23	29	1
8	23	30	1	23	29	1	23	29	1	23	30	1
9	23	31	0	23	30	1	23	30	1	23	31	0
10	23	31	0	23	31	0	23	31	0	23	31	0
11	23	31	0	23	31	0	23	31	0	23	31	1
12	23	31	0	23	31	0	23	31	1	23	30	1
13	23	31	1	23	31	1	23	30	1	23	29	1
14	23	30	2	23	30	1	23	29	2	23	28	2
15	23	28	2	23	29	2	23	27	2	23	26	2
16	23	26	2	23	27	2	23	25	2	23	24	3
17	23	24	3	23	25	3	23	23	3	23	21	3
18	23	21	3	23	22	3	23	20	3	23	18	4
19	23	18	3	23	19	3	23	17	3	23	14	4
20	23	15	4	23	16	4	23	13	4	23	10	4
21	23	11	4	23	12	4	23	9	4	23	6	5
22	23	7	5	23	8	4	23	5	4	23	1	5
23	23	2	5	23	4	5	23	0	5	22	56	6
24	22	57	5	22	59	6	22	55	5	22	50	6
25	22	52	6	22	53	5	22	49	6	22	44	6
26	22	46	6	22	48	7	22	43	6	22	38	7
27	22	40	7	22	41	6	22	36	7	22	31	7
28	22	33	7	22	35	7	22	29	7	22	24	7
29	22	26	7	22	28	7	22	22	7	22	17	7
30	22	19	7	22	21	7						

North declination.

North declination.

July.

	1		2		3		4	
	1609 1613 1617		1610 1614 1618		1611 1615 1619		1612 1616 1620	
Day.	De. Mi.	dif.	De. Mi.	dif.	De. Mi.	dif.	De. Mi.	dif.
1	22 11	8	22 13	8	22 15	8	22 9	9
2	22 3	9	22 5	9	22 7	9	22 0	8
3	21 54	9	21 56	9	21 58	8	21 52	9
4	21 45	9	21 47	9	21 50	9	21 43	10
5	21 36	10	21 38	9	21 41	10	21 33	9
6	21 26	10	21 29	10	21 31	10	21 24	11
7	21 16	10	21 19	11	21 21	10	21 13	10
8	21 6	11	21 8	10	21 11	11	21 3	11
9	20 55	11	20 58	11	21 0	11	20 52	11
10	20 44	11	20 47	12	20 49	11	20 41	12
11	20 33	12	20 35	11	20 38	11	20 29	12
12	20 21	12	20 24	12	20 27	12	20 17	12
13	20 9	13	20 12	13	20 15	13	20 5	12
14	19 56	13	19 59	13	20 2	12	19 53	13
15	19 43	13	19 46	13	19 50	13	19 40	13
16	19 30	13	19 33	13	19 37	14	19 27	14
17	19 17	14	19 20	13	19 23	13	19 13	14
18	19 3	14	19 6	14	19 10	14	18 59	14
19	18 49	15	18 52	14	18 56	15	18 45	15
20	18 34	14	18 38	15	18 41	14	18 30	14
21	18 20	15	18 23	15	18 27	15	18 16	15
22	18 5	16	18 8	15	18 12	15	18 1	16
23	17 49	15	17 53	15	17 57	16	17 45	15
24	17 34	16	17 38	16	17 41	15	17 30	16
25	17 18	16	17 22	16	17 26	16	17 14	17
26	17 2	17	17 6	17	17 10	17	16 57	16
27	16 45	16	16 49	16	16 53	16	16 41	17
28	16 29	17	16 33	17	16 37	17	16 24	17
29	16 12	18	16 16	17	16 20	17	16 7	17
30	15 54	17	15 59	18	16 3	18	15 50	18
31	15 37		15 41		15 45		15 32	

North declination.

North declination.

August.

Day.	1 1609 1613 1617			2 1610 1614 1618			3 1611 1615 1619			4 1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	15	19	18	15	24	18	15	28	18	15	14	18
2	15	1	18	15	6	19	15	10	18	14	56	18
3	14	43	19	14	47	18	14	52	19	14	38	19
4	14	24	18	14	29	19	14	33	18	14	19	18
5	14	6	19	14	10	19	14	15	19	14	1	19
6	13	47	19	13	51	19	13	56	19	13	42	20
7	13	28	20	13	32	19	13	37	19	13	22	19
8	13	8	19	13	13	19	13	18	20	13	3	20
9	12	49	20	12	54	20	12	58	21	12	43	19
10	12	29	20	12	34	20	12	39	20	12	24	20
11	12	9	21	12	14	20	12	19	20	12	4	21
12	11	48	20	11	54	21	11	59	21	11	43	20
13	11	28	20	11	33	20	11	38	20	11	23	21
14	11	8	21	11	13	21	11	18	21	11	2	21
15	10	47	21	10	52	21	10	57	21	10	41	21
16	10	26	21	10	31	21	10	36	21	10	20	21
17	10	5	21	10	10	21	10	15	21	9	59	21
18	9	44	21	9	49	21	9	54	21	9	38	21
19	9	23	22	9	28	22	9	33	21	9	17	22
20	9	1	22	9	6	21	9	12	22	8	55	22
21	8	39	21	8	45	22	8	50	22	8	33	22
22	8	18	22	8	23	22	8	28	22	8	11	22
23	7	56	22	8	1	22	8	6	22	7	49	22
24	7	34	23	7	39	22	7	44	22	7	27	22
25	7	11	22	7	17	23	7	22	22	7	5	22
26	6	49	23	6	54	22	7	0	23	6	43	23
27	6	26	22	6	32	23	6	37	22	6	20	22
28	6	4	23	6	9	22	6	15	23	5	58	23
29	5	41	22	5	47	23	5	52	22	5	35	23
30	5	19	23	5	24	23	5	30	23	5	12	23
31	4	56		5	1		5	7		4	49	

North declination.

North declination.

September.

	1		2		3		4	
	1609 1613 1617		1610 1614 1618		1611 1615 1619		1612 1616 1620	
Day.	De. Mi.	dif.	De. Mi.	dif.	De. Mi.	dif.	De. Mi.	dif.
1	4 33	23	4 38	23	4 44	23	4 26	23
2	4 10	23	4 15	23	4 21	23	4 3	23
3	3 47	23	3 52	23	3 58	23	3 40	23
4	3 24	24	3 29	23	3 35	23	3 17	23
5	3 0	23	3 6	23	3 12	24	2 54	23
6	2 37	23	2 43	24	2 48	23	2 31	24
7	2 14	24	2 19	23	2 25	23	2 7	23
8	1 50	23	1 56	23	2 2	24	1 44	24
9	1 27	24	1 33	24	1 38	23	1 20	23
10	1 3	23	1 9	23	1 15	24	0 57	23
11	0 40	24	0 46	24	0 51	23	0 34	24
12	0 16	23	0 22	23	0 28	24	0 10	24
13	0 7	24	0 1	24	0 4	23	0 14	23
14	0 31	23	0 25	23	0 19	24	0 37	24
15	0 54	24	0 48	24	0 43	23	1 1	23
16	1 18	23	1 12	24	1 6	24	1 24	24
17	1 41	24	1 36	23	1 30	23	1 48	23
18	2 5	23	1 59	24	1 53	24	2 11	24
19	2 28	24	2 23	23	2 17	23	2 35	23
20	2 52	23	2 46	24	2 40	24	2 58	24
21	3 15	24	3 10	23	3 4	23	3 22	23
22	3 39	23	3 33	23	3 27	24	3 45	23
23	4 2	23	3 56	24	3 51	23	4 8	24
24	4 25	24	4 20	23	4 14	23	4 32	23
25	4 49	23	4 43	23	4 37	24	4 55	23
26	5 12	23	5 6	24	5 1	23	5 18	23
27	5 35	23	5 30	23	5 24	23	5 41	24
28	5 58	23	5 53	23	5 47	23	6 5	23
29	6 21	23	6 16	23	6 10	23	6 28	23
30	6 44		6 39		6 33		6 51	

North declination.

South declination.

Æquinoctiall.

North declination.

South declination.

North declination.

October.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	7	7	23	7	1	23	6	56	23	7	13	23
2	7	30	22	7	24	23	7	19	22	7	36	23
3	7	52	23	7	47	22	7	41	23	7	59	22
4	8	15	22	8	9	23	8	4	23	8	21	22
5	8	37	23	8	32	22	8	27	22	8	43	23
6	9	0	22	8	54	22	8	49	22	9	6	22
7	9	22	22	9	16	22	9	11	22	9	28	22
8	9	44	22	9	38	22	9	33	22	9	50	22
9	10	6	21	10	0	22	9	55	22	10	12	21
10	10	27	22	10	22	22	10	17	22	10	33	22
11	10	49	22	10	44	21	10	39	21	10	55	21
12	11	11	21	11	5	22	11	0	21	11	16	22
13	11	32	21	11	27	21	11	21	22	11	38	21
14	11	53	21	11	48	21	11	43	21	11	59	20
15	12	14	20	12	9	20	12	4	20	12	19	21
16	12	34	21	12	29	21	12	24	21	12	40	21
17	12	55	20	12	50	20	12	45	20	13	1	20
18	13	15	20	13	10	20	13	5	21	13	21	20
19	13	35	20	13	30	20	13	26	20	13	41	20
20	13	55	20	13	50	20	13	46	19	14	1	19
21	14	15	19	14	10	20	14	5	20	14	20	20
22	14	34	20	14	30	19	14	25	19	14	40	19
23	14	54	19	14	49	19	14	44	19	14	59	19
24	15	13	18	15	8	19	15	3	19	15	18	18
25	15	31	19	15	27	18	15	22	19	15	36	19
26	15	50	18	15	45	18	15	41	18	15	55	18
27	16	8	18	16	3	18	15	59	18	16	13	18
28	16	26	17	16	21	18	16	17	18	16	31	17
29	16	43	18	16	39	18	16	35	17	16	48	17
30	17	1	17	16	57	17	16	52	18	17	5	17
31	17	18		17	14		17	10		17	22	

South declination.

South declination.

November.

South declination.

	1		2		3		4	
	1609 1613 1617		1610 1614 1618		1611 1615 1619		1612 1616 1620	
Day.	De. Mi.	dif.	De. Mi.	dif.	De. Mi.	dif.	De. Mi.	dif.
1	17 35	16	17 31	16	17 26	17	17 39	16
2	17 51	16	17 47	16	17 43	16	17 55	16
3	18 7	16	18 3	16	17 59	16	18 11	16
4	18 23	16	18 19	16	18 15	16	18 27	16
5	18 39	15	18 35	15	18 31	15	18 43	15
6	18 54	15	18 50	15	18 46	15	18 58	15
7	19 9	14	19 5	14	19 1	15	19 13	14
8	19 23	14	19 19	15	19 16	14	19 27	14
9	19 37	14	19 34	13	19 30	14	19 41	14
10	19 51	13	19 47	14	19 44	14	19 55	13
11	20 4	13	20 1	13	19 58	13	20 8	13
12	20 17	13	20 14	13	20 11	13	20 21	13
13	20 30	12	20 27	12	20 24	12	20 34	12
14	20 42	12	20 39	12	20 36	12	20 45	12
15	20 54	12	20 51	12	20 48	12	20 57	11
16	21 6	11	21 3	11	21 0	11	21 8	11
17	21 17	10	21 14	11	21 11	11	21 19	11
18	21 27	11	21 25	10	21 22	11	21 30	10
19	21 38	9	21 35	10	21 33	10	21 40	10
20	21 47	10	21 45	10	21 43	10	21 50	9
21	21 57	9	21 55	9	21 53	9	21 59	9
22	22 6	8	22 4	8	22 2	9	22 8	9
23	22 14	9	22 12	9	22 11	8	22 17	8
24	22 23	7	22 21	8	22 19	8	22 25	8
25	22 30	8	22 29	7	22 27	7	22 33	7
26	22 38	6	22 36	7	22 34	7	22 40	7
27	22 44	7	22 43	6	22 41	7	22 47	6
28	22 51	5	22 49	6	22 48	6	22 53	6
29	22 56	6	22 55	6	22 54	6	22 59	5
30	23 2		23 1		23 0		23 4	

South declination.

December.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	23	7	5	23	6	5	23	5	5	23	8	
2	23	12	4	23	11	4	23	10	4	23	13	4
3	23	16	4	23	15	4	23	14	4	23	17	4
4	23	20	3	23	19	3	23	18	3	23	20	3
5	23	23	2	23	22	3	23	21	3	23	23	3
6	23	25	2	23	25	2	23	24	3	23	26	3
7	23	27	2	23	27	2	23	26	2	23	28	2
8	23	29	1	23	29	1	23	28	2	23	30	2
9	23	30	1	23	30	1	23	30	1	23	31	1
10	23	31	0	23	31	0	23	31	0	23	31	0
11	23	31	0	23	31	0	23	31	0	23	31	0
12	23	31	0	23	31	0	23	31	0	23	31	1
13	23	31	1	23	31	1	23	31	1	23	30	1
14	23	30	2	23	30	2	23	30	1	23	29	2
15	23	28	2	23	28	2	23	29	2	23	27	2
16	23	26	3	23	26	2	23	27	2	23	25	3
17	23	23	3	23	24	3	23	25	3	23	22	3
18	23	20	3	23	21	3	23	22	3	23	19	3
19	23	17	4	23	18	3	23	19	3	23	16	3
20	23	13	5	23	14	4	23	15	4	23	12	4
21	23	8	5	23	10	4	23	11	4	23	7	5
22	23	3	5	23	5	5	23	6	5	23	2	5
23	22	58	5	23	0	5	23	1	5	22	57	5
24	22	52	6	22	54	6	22	55	6	22	51	6
25	22	46	6	22	48	6	22	49	6	22	44	7
26	22	39	7	22	41	7	22	43	7	22	37	7
27	22	32	7	22	34	7	22	36	7	22	30	8
28	22	25	8	22	26	8	22	29	8	22	22	8
29	22	17	8	22	18	8	22	21	8	22	14	8
30	22	8	9	22	10	9	22	13	9	22	6	9
31	21	59		22	1		22	4		21	57	

South declination.

South declination.

By the height of the Pole ſtarre to know the height of the Pole.

THe tables following are calculated for the end of the yeere 1610, ſeruing without ſenſible error for many yeeres to come; they ſhew the height of the Pole for conuenient latitudes, by the height of the Pole ſtarre, and the helpe of the guards, in eight ſeuerall poſitions: ſo that you may by helpe of them, in any place on the North ſide of the æquator, to the latitude of 74 degrees, or further, once in three houres euery cleere night, make a good obſeruation of the latitude. In the three laſt poſitions, if the height of the Pole be but little, the guards will be hid vnder the Horizon: notwithſtanding if by the houre of the night, or the height of any knowne ſtarre, by the helpe of a Globe, or Aſtrolabe, wee know when the ſtarres doe come to their due poſition, we may obſerue the Pole ſtarre, and finde the height of the Pole nere as well, as if they were aboue the Horizon. The poſitions are carefully to be obſerued, that the two ſtarres mentioned in the head of the table be either in the ſame Azimuth one directly ouer another (which is knowne, if looking with the one eye onely, a perpendicular corde will hide or couer them both) or elſe of the ſame altitude aboue the Horizon, which is diſcerned by the Croſſe-ſtaffe. At that inſtant that any ſuch poſition ſhall happen, take the height of the Pole ſtarre and the table anſwering to that poſition, ſhall giue you the height of the Pole.

For example; when the greater guard is directly vnder the Pole ſtarre, I finde the height of the Pole ſtarre to be 47 degrees and twentie minutes: I looke in the ſeuenth table, and find the height of the Pole for 47, to be 44 degrees, 36 minutes: to this I adde 20 minutes, becauſe the height of the ſtarre is 20 minutes aboue 47, then is the height of the Pole 44 degrees, 56 min. The ſeconds may ſafely be neglected, though they be inſerted in the table rather for ſatisfaction of the reader, in the certaintie of the calculation, then for any neceſſarie vſe.

If when the greater guard is in the Eaſt, of equall height with the Pole ſtarre, I finde the height of that ſtarre to be 75 degrees, 40 minutes. In the firſt table I finde the height of the Pole anſwering to 75 deg. to be 77 deg. 26 min. and the difference one degree, three minutes: the part proportionall whereof for 40 minutes, is 42 min. which added to 77 degrees, 26 min. maketh the true eleuation of the Pole 78 degrees, 8 minutes.

Where the height of the Pole ſtarre is but little, there wee muſt ſubduct the refraction from the height obſerued: otherwiſe we ſhall alwaies finde the height more then in truth it is. This refraction cauſeth the obſeruations of the Sunne at the South, and at the North, (when the Sunne neuer ſetteth in Northren climates) to giue ſeuerall latitudes in the ſame place, the obſeruation at the North alwaies making the latitude too great. Concerning this refraction, ſee page 232.

When the greater guard is in the East of the same height with the Pole starre.

Height of the Pole starre.	Et guarde Height of the Pole.			Height of the Pole starre.	Et guarde Height of the Pole.			Height of the Pole starre.	Et guarde Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	2	26	49	28	29	35	46	55	56	50	52
2	3	27	8	29	30	36	9	56	57	51	46
3	4	27	26	30	31	36	33	57	58	52	42
4	5	27	44	31	32	36	57	58	59	53	41
5	6	28	2	32	33	37	22	59	60	54	44
6	7	28	21	33	34	37	47	60	61	55	50
7	8	28	40	34	35	38	13	61	62	57	0
8	9	28	58	35	36	38	39	62	63	58	14
9	10	29	17	36	37	39	6	63	64	59	33
10	11	29	36	37	38	39	34	64	66	0	58
11	12	29	55	38	39	40	3	65	67	2	28
12	13	30	14	39	40	40	31	66	68	4	3
13	14	30	33	40	41	41	1	67	69	5	46
14	15	30	53	41	42	41	32	68	70	7	38
15	16	31	12	42	43	42	3	69	71	9	40
16	17	31	32	43	44	42	36	70	72	11	13
17	18	31	52	44	45	43	9	71	73	14	20
18	19	32	11	45	46	43	44	72	74	17	0
19	20	32	32	46	47	44	20	73	75	19	54
20	21	32	52	47	48	44	57	74	76	23	0
21	22	33	13	48	49	45	36	75	77	26	19
22	23	33	34	49	50	46	15	76	78	29	51
23	24	33	55	50	51	46	57	77	79	33	36
24	25	34	17	51	52	47	40	78	80	37	36
25	26	34	38	52	53	48	25	79	81	41	49
26	27	35	1	53	54	49	12	80	82	46	17
27	28	35	23	54	55	50	1				

When the two guards are of equall height betwixt the East and the highest.

Height of the Pole starre.	☊ ☋ Height of the Pole.			Height of the Pole starre.	☊ ☋ Height of the Pole.			Height of the Pole starre.	☊ ☋ Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	3	46	20	28	30	46	37	55	57	42	26
2	4	46	23	29	31	46	36	56	58	41	57
3	5	46	25	30	32	46	33	57	59	41	26
4	6	46	27	31	33	46	31	58	60	40	51
5	7	46	29	32	34	46	29	59	61	40	11
6	8	46	31	33	35	46	26	60	62	39	26
7	9	46	32	34	36	46	22	61	63	38	36
8	10	46	34	35	37	46	19	62	64	37	39
9	11	46	36	36	38	46	15	63	65	36	34
10	12	46	37	37	39	46	10	64	66	35	19
11	13	46	38	38	40	46	5	65	67	33	53
12	14	46	39	39	41	46	0	66	68	32	14
13	15	46	40	40	42	45	54	67	69	30	19
14	16	46	41	41	43	45	47	68	70	28	3
15	17	46	42	42	44	45	40	69	71	25	21
16	18	46	43	43	45	45	32	70	72	22	7
17	19	46	43	44	46	45	23	71	73	18	13
18	20	46	43	45	47	45	14	72	74	13	30
19	21	46	43	46	48	45	3	73	75	7	36
20	22	46	43	47	49	44	52	74	76	0	4
21	23	46	44	48	50	44	39	75	76	50	17
22	24	46	43	49	51	44	25	76	77	36	46
23	25	46	43	50	52	44	10	77	78	17	2
24	26	46	42	51	53	43	53	78	78	47	20
25	27	46	41	52	54	43	35				
26	28	46	40	53	55	43	14				
27	29	46	39	54	56	42	51				

When the greateſt guard is directly aboue the Pole ſtarre.

Height of the Pole ſtarre.	A° Height of the Pole.			Height of the Pole ſtarre.	A° Height of the Pole.			Height of the Pole ſtarre.	A° Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	3	22	29	28	30	21	55	55	57	20	51
2	4	22	28	29	31	21	53	56	58	20	47
3	5	22	27	30	32	21	52	57	59	20	43
4	6	22	26	31	33	21	50	58	60	20	38
5	7	22	25	32	34	21	48	59	61	20	34
6	8	22	23	33	35	21	47	60	62	20	28
7	9	22	22	34	36	21	45	61	63	20	23
8	10	22	21	35	37	21	43	62	64	20	17
9	11	22	20	36	38	21	41	63	65	20	11
10	12	22	19	37	39	21	39	64	66	20	4
11	13	22	17	38	40	21	38	65	67	19	57
12	14	22	16	39	41	21	36	66	68	19	48
13	15	22	15	40	42	22	33	67	69	19	40
14	16	22	14	41	43	21	31	68	70	19	30
15	17	22	13	42	44	21	29	69	71	19	20
16	18	22	11	43	45	21	27	70	72	19	8
17	19	22	10	44	46	21	25	71	73	18	55
18	20	22	9	45	47	21	22	72	74	18	40
19	21	22	7	46	48	21	20	73	75	18	23
20	22	22	6	47	49	21	17	74	76	18	4
21	23	22	5	48	50	21	14	75	77	17	42
22	24	22	3	49	51	21	11				
23	25	22	2	50	52	21	8				
24	26	22	1	51	53	21	5				
25	27	21	59	52	54	21	2				
26	28	21	58	53	55	20	59				
27	29	21	56	54	56	20	55				

When the two guards are directly one ouer another betwixt the highest and the west.

Height of the Pole starre.	N°. W°. Height of the Pole.			Height of the Pole starre.	N°. W°. Height of the Pole.			Height of the Pole starre.	N°. W°. Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	1	20	22	28	28	38	3	55	56	8	51
2	2	20	58	29	29	38	50	56	57	10	44
3	3	21	34	30	30	39	37	57	58	12	43
4	4	22	11	31	31	40	25	58	59	14	49
5	5	22	47	32	32	41	15	59	60	17	2
6	6	23	23	33	33	42	5	60	61	19	23
7	7	24	0	34	34	42	57	61	62	21	53
8	8	24	37	35	35	43	50	62	63	24	34
9	9	25	13	36	36	44	44	63	64	27	25
10	10	25	50	37	37	45	40	64	65	30	30
11	11	26	28	38	38	46	37	65	66	33	48
12	12	27	5	39	39	47	35	66	67	37	23
13	13	27	43	40	40	48	36	67	68	41	16
14	14	28	21	41	41	49	38	68	69	45	30
15	15	29	0	42	42	50	42	69	70	50	7
16	16	29	38	43	43	51	48	70	71	55	13
17	17	30	18	44	44	52	56	71	73	0	52
18	18	30	57	45	45	54	7	72	74	7	9
19	19	31	37	46	46	55	20	73	75	14	8
20	20	32	18	47	47	56	36	74	76	21	52
21	21	32	59	48	48	57	55				
22	22	33	40	49	49	59	17				
23	23	34	22	50	51	0	43				
24	24	35	5	51	52	2	12				
25	25	35	48	52	53	3	45				
26	26	36	33	53	54	5	22				
27	27	37	17	54	55	7	4				

When the greater guard is in the weſt, of the ſame height with the Pole ſtarre.

Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
2	0	34	7	29	27	43	27	56	55	0	53
3	1	34	26	30	28	43	52	57	56	2	1
4	2	34	44	31	29	44	18	58	57	3	12
5	3	35	3	32	30	44	44	59	58	4	26
6	4	35	22	33	31	45	11	60	59	5	43
7	5	35	41	34	32	45	39	61	60	7	8
8	6	36	0	35	33	46	7	62	61	8	39
9	7	36	19	36	34	46	36	63	62	10	18
10	8	36	38	37	35	47	6	64	63	12	5
11	9	36	57	38	36	47	37	65	64	13	59
12	10	37	17	39	37	48	8	66	65	16	4
13	11	37	36	40	38	48	40	67	66	18	21
14	12	37	56	41	39	49	15	68	67	20	53
15	13	38	16	42	40	49	49	69	68	23	37
16	14	38	37	43	41	50	25	70	69	26	38
17	15	38	57	44	42	51	2	71	70	29	40
18	16	39	18	45	43	51	40	72	71	33	13
19	17	39	39	46	44	52	21	73	72	37	28
20	18	40	0	47	45	53	3	74	73	42	42
21	19	40	21	48	46	53	46	75	74	49	8
22	20	40	43	49	47	54	31	76	75	56	59
23	21	41	5	50	48	55	17	77	77	6	26
24	22	41	28	51	49	56	7	78	78	17	40
25	23	41	51	52	50	56	59	79	79	30	54
26	24	42	14	53	51	57	53	80	80	46	22
27	25	42	38	54	52	58	49				
28	26	43	2	55	53	59	48				

When the two guards are of equall height betwixt the West and the lowest.

Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
3	0	13	50	30	27	16	9	57	54	24	47
4	1	13	53	31	28	16	17	58	55	25	31
5	2	13	56	32	29	16	26	59	56	26	19
6	3	14	0	33	30	16	36	60	57	27	12
7	4	14	3	34	31	16	46	61	58	28	10
8	5	14	6	35	32	16	56	62	59	29	14
9	6	14	10	36	33	17	7	63	60	30	26
10	7	14	14	37	34	17	18	64	61	31	45
11	8	14	18	38	35	17	30	65	62	33	14
12	9	14	22	39	36	17	43	66	63	34	54
13	10	14	26	40	37	17	56	67	64	36	47
14	11	14	30	41	38	18	10	68	65	38	57
15	12	14	35	42	39	18	25	69	66	41	26
16	13	14	39	43	40	18	40	70	67	44	22
17	14	14	44	44	41	18	57	71	68	47	48
18	15	14	49	45	42	19	14	72	69	51	48
19	16	14	55	46	43	19	33	73	70	56	40
20	17	15	0	47	44	19	53	74	72	2	46
21	18	15	6	48	45	20	14	75	73	10	39
22	19	15	12	49	46	20	36	76	74	21	29
23	20	15	18	50	47	21	0	77	75	37	16
24	21	15	24	51	48	21	26	78	77	1	13
25	22	15	31	52	49	21	53				
26	23	15	38	53	50	22	23				
27	24	15	45	54	51	22	55				
28	25	15	53	55	52	23	29				
29	26	16	1	56	53	24	7				

When the greater guard is directly vnder the Pole starre.

Height of the Pole starre.	☉ Height of the Pole.			Height of the Pole starre.	☉ Height of the Pole.			Height of the Pole starre.	☉ Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
3	0	37	26	31	28	36	51	59	56	35	48
4	1	37	25	32	29	36	50	60	57	35	44
5	2	37	24	33	30	36	48	61	58	35	40
6	3	37	23	34	31	36	47	62	59	35	36
7	4	37	22	35	32	36	45	63	60	35	31
8	5	37	21	36	33	36	44	64	61	35	26
9	6	37	19	37	34	36	42	65	62	35	21
10	7	37	18	38	35	36	40	66	63	35	15
11	8	37	17	39	36	36	38	67	64	35	10
12	9	37	16	40	37	36	37	68	65	35	3
13	10	37	15	41	38	36	35	69	66	34	56
14	11	37	14	42	39	36	33	70	67	34	49
15	12	37	12	43	40	36	31	71	68	34	40
16	13	37	11	44	41	36	29	72	69	34	31
17	14	27	10	45	42	36	27	73	70	34	22
18	15	37	9	46	43	36	25	74	71	34	11
19	16	37	7	47	44	36	23	75	72	33	59
20	17	37	6	48	45	36	20	76	73	33	45
21	18	37	5	49	46	36	18	77	74	33	30
22	19	37	4	50	47	36	15	78	75	33	13
23	20	37	2	51	48	36	13	79	76	32	54
24	21	37	1	52	49	36	10	80	77	32	30
25	22	37	0	53	50	36	7	81	78	32	4
26	23	36	58	54	51	36	5	82	79	31	34
27	24	36	57	55	52	36	2	83	80	30	54
28	25	36	56	56	53	35	58	84	81	30	7
29	26	36	54	57	54	35	55	85	82	29	7
30	27	36	53	58	55	35	52	86	83	27	50

When the two guards are in the ſame Azimuth, or the one directly ouer the other betwixt the loweſt and the Eaſt.

Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	0	40	50	28	27	58	43	55	55	30	47
2	1	41	27	29	28	59	31	56	56	32	47
3	2	42	3	30	30	0	19	57	57	34	54
4	3	42	39	31	31	1	9	58	58	37	9
5	4	43	16	32	32	1	59	59	59	39	32
6	5	43	52	33	33	2	51	60	60	42	4
7	6	44	29	34	34	3	44	61	61	44	46
8	7	45	6	35	35	4	39	62	62	47	41
9	8	45	43	36	36	5	34	63	63	50	48
10	9	46	20	37	37	6	32	64	64	54	11
11	10	46	58	38	38	7	30	65	65	57	51
12	11	47	36	39	39	8	31	66	67	1	49
13	12	48	14	40	40	9	33	67	68	6	11
14	13	48	52	41	41	10	38	68	69	10	59
15	14	49	31	42	42	11	44	69	70	16	16
16	15	50	10	43	43	12	53	70	71	22	11
17	16	50	50	44	44	14	4	71	72	28	54
18	17	51	30	45	45	15	17	72	73	36	34
19	18	52	10	46	46	16	33	73	74	45	18
20	19	52	52	47	47	17	53	74	75	55	14
21	20	53	33	48	48	19	15				
22	21	54	15	49	49	20	41				
23	22	54	58	50	50	22	11				
24	23	55	42	51	51	23	45				
25	24	56	26	52	52	25	23				
26	25	57	11	53	53	27	5				
27	26	57	57	54	54	28	54				

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FINIS.

An Addition touching the variation of the Compasse.

WHereas there haue been some of opinion that there be two Magneticall poles, by knowledge whereof, and of the magneticall variation obserued in any place, they haue imagined they could finde the longitude thereof: to shew the great error and vncertaintie of this their opinion, I haue here set downe this Table of obseruations of the variation of the Magneticall Needle, which partly by my selfe, but for the most part by others, both English and strangers haue bin taken in all parts of the world almost, whither any Nauigation hath bin made, for these many yeeres. Which obseruations I wish the iudicious reader to compare together with so good aduice and iudgement as he can: whereby I assure my selfe he will bee enforced to acknowledge with me, that there can bee no such magneticall poles found, as they imagine. To proue this, a few instances may be sufficient amongst many that may be gathered out of these obseruations. For if there bee two such Magneticall poles, there can be but one common magneticall meridian passing by them and the poles of the world: but by these obseruations it is manifest that there be many magneticall meridians passing by the poles of the world: as namely, the magne-

ticall meridian about *Trinidado* and *Barbudas*: alſo the meridian about the weſtermoſt of the *Azores*: alſo about *P.das Agulhas*: laſtly, amongſt the Eaſt Indian Ilands ſomewhat beyond *Iaua Maior*, the magneticall and true meridian muſt needes agree in one. Now ſeeing that all theſe magneticall meridians paſſe by the poles of the world, there can be no reaſon giuen why the magneticall poles ſhould be ſaid to be in one of them more then in another: and if in any, then in all: whereof it muſt needs follow, that as many magneticall meridians as you haue that paſſe by the poles of the world, ſo many paire of magneticall poles muſt you haue, which is abſurd; and therefore no ſuch magneticall poles.

Now if any ſhall thinke that the great difference that is found betwixt diuers of theſe obſeruations, taken at the ſame place by diuers obſeruers, doth make any thing againſt the intention of this argument, he is much deceiued. For although there be three or foure degrees difference betwixt ſome obſeruations taken at the ſame place; as namely at S.*Helena*, ſome make the variation to be almoſt three degrees, ſome almoſt foure: others will haue it to be about fiue degrees and an halfe, and ſome others ſeuen and an halfe. And although there bee ſome foure or fiue ſcore leagues difference in determining the place where the true and magneticall meridian ſhould concurre, or where there ſhould be no variation about *Flores* & *Coruo*, and about *P.das Agulhas*, ſome making it to bee about ſeuentie or eightie leagues Weſtward from *Flores*; and ſome about thirtie leagues Eaſtward from thence; where

ſome

some others will haue it hard by *Flores*, or somwhat to the Eastwards thereof: And at *P. das Agulhas* some say there is no variation at all, but according to others wee must goe 80 leagues further to the Eastward before wee come to no variation. All these differences notwithstanding how great soeuer they be, can be of no validitie to infringe the force of the foresaid argument; for still these obseruations will necessarily proue, that either at *Flores* and at *P. das Agulhas*, or at the most within three or foure score leagues of those places, there is a magneticall meridian passing by both the poles of the world; which two meridians differing so much in longitude each from other, and hauing in all latitudes great variations betwixt them, it cannot be with any reason imagined how they may bee reduced into one, so to make two magneticall poles only. But of all these so great differences either of the same or of diuers mens obseruations, we may iustly take occasion to admonish all sea-men, especially such as are to take charge, that they be very carefull both in prouiding themselues of the most conuenient instruments that can be gotten for this purpose, and also in the circumspect and artificial handling of them whensoeuer they goe about to make vse of them in obseruing to finde the variation, considering how great and excellent vse there may bee made hereof, for finding out the place whereabouts you are betwixt East and West vpon the huge and vast Ocean, though you haue seene no land for a long time.

	Variat. West.		Latit. North.	
	De.	Mi.	De.	Mi.
In the Ice hauen at Noua zembla	22	30	76	0
On the Weſt ſide of Noua zembla	26	0	76	0
From Noua zembla Weſtward 20. leagues	31	0	73	0
At Croſſe Iland neere Noua zembla	17	0		
At the Hollanders Newland	16	0	81	0
In the Iland of Vaygats	7	0	71	0
Amongſt the Iles of Vaygats	8	0	70	25
At S. Iames Ile	7	30	70	40
On land neere the barre of Pechora	3	30	69	10
At the North Cape	1	0	71	30
From Fowlay Iland halfe way almoſt to Friſland	11	15		
From Friſeland halfe way to Labrador, now called Newfoundland	28	0	62	0
	Eaſt.			
Neere England ſayling from Yarmouth Northwards	12	40	55	14
In the way from London to Ruſſia	13	0	55	20
	Weſt.			
	3	30	69	0
	7	0	70	40
	8	0	70	30
	Eaſt.			
	4	0	65	40
	5	10	64	30
	3	0	66	30

	Variat. East. De. Mi	*Latit. North.* De. Mi.
At Antwerpe in Brabant	9 0	
Neere London at Limehouse	11 0	51 32
	11 15	
About Portland	10 0	
In S. Iues Churchyard in Cornwall	8 0	50 30
From Cape Lizard South by West 8. leag.	12 50	49 55
South easterlie from C. Cleare comming from our Channell	7 36	
At Youghall in Ireland	10 0	
At Syllie	10 0	
From Bell Ile eastward 350 leagues	1 0	52 10
From Syllie West Northwest 235 leagues	0 0	54 0
	West.	
From Syllie West Northwest fiue hundred and thirtie leagues	10 0	60 0
From that place Northwest by North	16 0	3 30
From thence North and by West	22 0	66 0
From this last place North by West	28 0	73 0
From thence due West 40 leagues	33 0	73 0
At the Earle of Cumberlands Iles	30 0	64 0
At Hope Sanderson	28 0	72 12
At Cape Rase in Newfoundland	16 0	47 0
Frō Cape Rase South by West Southerly	2 52	34 35
	5 37	35 30
From C. Rase South Southwest Southerly	6 30	39 40
	East.	
At Cape Finisterre	8 30	
From Cape Finister West by N. 28 leagues	7 55	43 20

	Variat. Eaſt. De. Mi.	*Latit. North.* De. Mi.
From the Rock { Weſtward about 50 leag.	6 15	39 10
From the Rock { Weſt Northweſt 7 leag.	7 0	
About Lisbone	6 30	
From Lisbone to C. Verde almoſt	8 30	
From C. Saker 3 or 4 leagues Eaſtward	5 38	
From S. Maries (one of the Azores) 9 leag. Eaſt by South	2 20	
At Fayal, and from thence to Tercæra	3 45	
From Tercæra to Lisbone {	7 30	
From Tercæra to Lisbone {	8 30	
From Flores Eaſtward ſcarce 40 leagues, and from C. Blanco 300 leagues	4 0	
From Flores Eaſtward 70 or 80 leagues	0 0	
Hard by Flores or betwixt it and Fayal	0 0	
From Flores Weſtward 30 leagues	0 0	
	Weſt.	
Croſſing the meridian of Flores & Coruo	1 0	
From Flores 100 or 120 leagues Weſtward {	2 0	
From Flores 100 or 120 leagues Weſtward {	1 0	
Within ſight of Flores Southeaſt frō thence	5 37	
From Flores Weſt 230 leagues	3 30	39 19
Falling with the Pike	1 30	
From the Canaries 300 leagues	1 0	19 0
	Eaſt.	
At the Canaries	5 37	
From the Grand Canarie Northward	4 37	32 0
Northeaſt from the Ile Saluages	5 37	31 0
On the Southweſt ſide of ỹ Grand Canarie	5 20	28 0
From the Canaries 230 leagues	0 0	20 0

Sailing

	Variat. East. De.	Mi.	*Latit. North.* De.	Mi.
Sailing for the Canaries from the West Indies	0	0	33	0
	0	0	31	0
Sailing further in	5	37	27	20
From Palma sailing towards Cape Blanco	3	0	24	0
Neere to C.Blanco not two leag.frō shore	2	40	21	0
Riding at anchor neere C.Blanco	3	0	20	25
From C.Blanco West S.w. some 20 leag.	2	40		
From C.Blanco Westward 63 leagues	5	37	19	20
From C.Blanco Westward 90 leagues	5	0	18	35
From C.Blanco Westward 100 leagues	6	0		
From C.Blanco 436 leagues	7	30	17	42
From C.Blanco 470 leagues	7	30	11	57
From C.Blanco 476 leagues	7	36	16	35
From C.Blanco 535 leagues	7	30	10	59
From C.Blanco 595 leagues	5	0	10	15
From C. Blanco 640 leagues	4	36	10	0
From C.Blanco 700 leagues Westward	1	3	9	20
From C.Blanco going towards the West Indies in many distances	6	0	14	54
	5	40		
At Cape Verde	7	0		
About the Ilands of C.Verde	4	0		
From these Ilands 300 leagues Westward	5	38		
At S.Iago and S.Nicholas Iles of C.Verde	2	30		
From C.Verde 100 ōr 120 leagues	3	45	14	0
Frō ỹ Iles of Braua & Fogo W. N.w.12 leag.	4	30		
From Maio 46 leagues East by South	5	8	14	20
From Cape Verde in the way to the East Indies passing the æquinoctial	4	0		
	5	0		
	5	37		

	Variat. Eaſt.		*Latit. North.*	
	De.	*Mi.*	*De.*	*Mi.*
At the Iland of Trinidado	0	0	9	46
From Trinidado Iland eaſtw. 90 leag.	1	30		
	2	0		
	Weſt.			
At Margarita	0	0		
At S. Cruce neere S. Iohn de Porto Rico	0	0		
At Cape Roſſe of S. Iohns Iland	1	52	17	44
In the meridian of Porto Rico	2	52	21	30
At anker on the Weſt ſide of S. Iohn	1	52		
At the Weſt end of S. Iohn de Porto Rico	2	30	17	44
From S. Iohn de P. Rico North northweſt northerly halfe a point	8	0	23	0
Alſo in the ſame courſe	8	0	26	0
Againe in the ſame courſe	8	0	26	20
From Dominica about ſome 140 leagues	0	0	14	0
In the meridian of Barbados fiftie leagues from Martinico	0	0	14	20
At the Iland of Guardelupo	1	0	15	18
At Curſands an Iland of the Weſt Indies	4	0	12	13
At the towne of Rio de Hacha	7	36	11	20
At Cape la vela	7	0	11	50
Thwart Rio de Mayo	15	0	31	0
	15	0	36	0
At Cape Codera	2	30	9	30
At Cape Corientes in Cuba	3	0		
At Cape S. Anthonie in Cuba	13	0	22	0
At Cape Cameron	5	0	25	40
At Cape Florida	3	0	25	30
To the Northward of the Cape of Florida	13	0	28	0

			Variat. West.		*Latit. North.*	
			De.	*Mi.*	*De.*	*Mi.*
Neere the coast of America			11	0	35	30
From Barmudas Westward 140 leagues			10	0	30	35
From Barmudas Westward 100 leagues			10	3	34	0
Againe from Barmudas 80 or 85 leagues			11	15	34	0
From Cape Raso S.Southwest Southerly			6	30	39	40
			East.			
From Serraleona West by South, and from the shoalds of Madrabombe or S.Anne West and by North 106 leagues			6	10	7	0
In the harbour of Serraleona			1	50	8	30
From the shoare of Serraleona 17 leagues			2	2	3	54
Frō Serraleona 61 leagues West Southerly			2	56	7	58
From the meridian of Sierra-leona Westward	76	leagues	3	29	7	25
	97		3	45	6	0
	153		4	20	4	50
	137		4	12	4	40
	127		3	56	4	30
	142		4	20	4	18
	160		4	58	4	6
	187		4	50	3	0
	187		5	40	1	50
	194		5	45	0	45
					South.	
	195		5	26	0	10
	198		5	30	0	35
	206		6	33	2	0
	210		6	55	2	35
	220		6	45	3	35

From

	Variat. Eaſt.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From C.S. Auguſtine North and by Weſt—	7	0	7	16
Frō C.S. Auguſtine North by East Eaſterly—	6	40	1	4
From C.S. Auguſtine North Northeaſt—	8	0	4	0
From Cape S. Auguſtine Eaſt northerly 30 leagues—	8	10	8	20
From C.S. Auguſtine 100 leagues—	11	6	8	30
From C.S. Auguſtine not 120 leagues—	5	37	11	30
At the Ile Fernando Laronho neere Braſil—	8	30	2	20
Cloſe by the coaſt of Braſil—	3	45	7 8 10	0 0 0
A little Weſt from the meridian of Trinidad neere Braſil—	11	10	18	30
Among the Ilands of Trinidad & Aſcenſion	12	8	20	35
On the backſide of the Ile of Aſcenſion—	12	10	20	30
At the Ile of Aſcenſion—	10	0	20	0
In the meridian of Trinidad Eaſterly—	14	53	27	0
Between the Iles of Trinidad and Triſtan de Acunha—	18 19	0 0		
From the ſhoalds of Braſil Eaſt Southerly about 14 leagues—	12	30	19	30
From the ſame ſhoalds Southeaſt about 55 leagues—	13	52	20	10
Alſo frō the ſame ſhoalds Southeaſt by Eaſt—	13	20	19	37
From the coaſt of Braſil 150 leagues—	10	0	18	0
At Cape S. Vincent in Braſil—	12	0		
From the coaſt of Braſil 100 or 120 leagues	8 7	30 30	17 18	0 0
From Laronho Southweſt 12 leagues—	8	1	4	20

From

	Variat. East.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From Ascension Ile 20 or 30 leagues Eastward at the Cliffe Penedo de S.Pedro	5	30		
Betwixt Ascension Ile and S.Helens	7	30		
At S.Helena	2	48		
	3	46		
	5	37		
	7	30		
From S.Helena a little Westward	9	0		
From S.Helens not 19 leagues	5	40	18	30
From S.Helena Northwest by West 16 leag.	3	45		
From S.Helena Northwest 156 leagues	7	40	10	20
From S.Helena 230 leagues	5	38	8	20
From Ascension Ile Northeast halfe a point Northerly about 12 leagues	6	0		
About the Ilands of Martinvaz	13	0	19	0
Alongst by those Iles	11	15		
From those Ilands northerly 30 leagues	18	30		
From the shoare of Affrick Westward some 130 leagues	4	8	27	0
Bearing from thence toward S.Helena	2	48	25	0
From the maine of Africa 160 leagues	2	50	23	0
In the longitude of 28 degrees	15	20	32	0
A little Westward from the meridian of the Iles of Martinvaz	14	58	28	35
Eastward from thence	15	37	28	53
From the former obseruation 60 leagues	16	8	29	0
From the last obseruation Eastward 27 leag.	16	52	29	33
Beyond Tristan da cunha 70 or 80 leagues comming from Martinvaz	16	53	33	0

	Variat. East. De. Mi.	Latit. South. De. Mi.
From Triſtan da cunha Weſtward	17 52	34 35
	14 0	
At the Iland of Triſtan da cunha	19 0	
From thence Northward	16 8	33 34
Paſt the Iland towards C. Bona Speranza	14 0	
From Triſtan da cunha W.N.W. 368 leag.	14 0	23 25
At Cape Frio	13 0	
Neere Cape Frio	12. 0	23 30
From Cape Frio Eaſtward towards Africa	17 0	
	18 0	
From Cape Frio about 125 leag. Eaſtward	11 8	
About 155 leagues from Cape Frio	14 8	25 0
At Port deſire	5 0	47 40
At the Eaſt mouth or entrance into Magellans ſtraits	5 30	
In the ſtraits of Magellan	5 0	
From Cape Bonæ ſpei 900 leagues Weſt by North halfe a point Northerly	15 52	26 50
From Cape Bonæ ſpei almoſt Weſt by N. 80 leagues	8 50	34 0
At the bay of Soldania	0 20	33 55
	1 30	33 20
At Cape Buona Eſperanza	0 15	
	1 30	
About Cape Buona eſperanza	2 0	35 0
From Cape Buona Eſperanza Weſtwards 30 or 40 leagues	5 38	
Betwixt C. Buona eſperanza and S. Helena	3 45	

From

variation of the Compasse.

	Variat. East.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From C. Buona Esperanza South	3	45		
From C. Bona Speranza Westward 40 or 50 leagues	3	0		
From C. Buona esperanza due Northwest	5	37	20	0
	West.			
From C. Bonæ spei Sw. by S. 36 leagues	4	10	35	25
From C. Bonæ spei Sw. by S. 28 leagues	3	50	35	30
At Cape das Agulhas neete C. Bonæ spei	0	0		
From thence 80 leagues Eastward	0	0		
At Cape Talhada 40 leagues East frō Cape das Agulhas, being in sight of land lying from vs North by East	3	47	34	20
At C. Corientes beyond C. Bonæ spei	7	30		
	11	0	25	0
From C. Corientes Southwards	8	30	30	30
About the Ilands Primeras towards Mozambique	15	0	18	0
In the Ile Mozambique	12	0	14	45
			North.	
At the Iles of Nicobar	7	36	7	30
	10	0		
From thence till you come to the line going towards the East Indies	11	0		
At the Ile de Almirant neere the line	13	0		
Neere to C. Guarda fui, or Porto Galeacea	8	15	13	15
At P. de estreito or ŷ mouth of the Red sea	5	15	12	15
At Baxos de Cuaquem	1	15	19	15
At Port de Igidid	0	40	22	0

	Variat. West. De. Mi.	Latit. North. De. Mi.
At Xuarit	0 15 East.	
At Sidon in the bottome of the Streights	2 35	33 30
	West.	North.
From the place that is 200 leag. Westward from Goa to Cape Comorin	15 0	
At Goa	15 0	15 20
At the Iles Comoro	13 0	
In the Bay of S. Augustine in Madagascar	15 0	
At C. Romano in Madagascar	17 40	26 0
Neere Madagascar	8 30	26.0 / 20.0
From C. Romano Southerly	14 4	27 / 30
From C. Romano West Southwest halfe a point Southerly 110 leagues	14 14	36 34
From C. Romano Southwest 50 leagues	15 25	28 20
In the height of C. Romano 8 leagues off	16 45	25 50
At the Ile of S. Mary entring the Bay of Antongil	17 0	17 0
In the bottome of the Bay of Antongil by many and exact obseruations	20 0	
At the Bay of Tanassarin	5 30	
At the West side of ý sands of Saya de Malha	15 0	11 30
At the Iland Ragapez	23 11	10 0
From the Iland of Gratia West Southwest 36 leagues	24 11	9 20
At the shoalds called Baixòs de India	8 30	30 0
At Diego Roi- Iland	21 0	20 0

From

	Variat. West. De. Mi.	Latit. South. De. Mi.
From Los Romeros Iles South Westerlie 68 leagues	24 15	31 0
From Los Romeros East by South 50 leag.	22 16	
From Los Romeros East 110 leagues	21 20	
At the shoalds of Adu and Candu	19 30	6 0
At the Ile Diego Gratiosa	24 0	9 0
From Diego Gratiosa Westward 20 leagues	22 0	7 30
At Diego Roderigos Iland	20 0	
From Diego Rodericos Iland South, and South and by East	23 / 24 / 25	35 0
At Maldiuiæ Ilands	17 0	
		North.
At Cochin	13 0	9 40
From Cochin till you be past Maldiuiæ Iles South and Southwest till you be vnder 8 and 10 degrees of South latitude	16 52	
At Zeilan	15 30	9 0
At the Ile Pulobatum	4 0	4
At Achin in Sumatra	8 0	
In the Roade of Achin	6 30	
		South.
In Priaman on the West side of Sumatra	5 40	0 22
At Bantam in Iaua	5 0 / 4 30	7 0
At Madura	2 30	6 50
At the Northeast corner of Balij	3 0	8 30
At Banda	4 45	4 50

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Faults escaped amend thus.

Pag.	lin.	Faults.	Correct.
3	2	degree,	degree:
	24	ſhew	ſheweth
11	12	lying of	lying, or
	27	ſtowage and	ſtowage, and
	30	vnmeete and	vnmeete, and
	31	ſea as	ſea, as
12	21	geſſe	gheſſe
15	12	o her	other,
17	4	preciſe	preciſe,
126	28	minute and ſecond	and minute
182	18	R. and C	R & C
	22	M, and	M &,
207	5	of all	of the
213	31	tranſuerſaries	tranſuerſarie
214	13	incurre	concurre
219	12	we mentio-	we haue mentio-
233	6	guids	guides
236	32	and a	and an
349	19	Epicicle	Epicycle
359	3	the 6 of	the 26 of
388	13	multiplie	multiplied
429	2	the weſt	the weſt
448	26	ſame	ſunne
450	13	Semediameter	Semidiameter.
455	25	both if he	both, if he
455	26	ſo mall	ſo ſmall

In the ſhort Treatiſe of Nauigation.

9	13	a halfe	an halfe
10	10	one and twentieth	eleuenth
10	11	three and twentieth	thirteenth
10	12	two and twentieth	twelfth
10	13		
20	16	one part	the part
42	26	one ſecond	an half
	28		

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